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ST. THOMAS' CHURCH IN THE LIBERTY OF THE ROLLS.

ERECTED FROM THE DESIGNS, AND UNDER THE JOINT SUPERINTENDENCE OF C. DAVY, AND J. JOHNSON, ESQRS., ARCHITECTS.

(With Two Plates.)

THE Church of St. Thomas, in Bream's Buildings, was erected for the use of that part of the parish of St. Dunstan in the West, which lies in the county of Middlesex, and which is known as the Liberty of the Rolls*. The population of the Liberty amounts to 2440; and, prior to the erection of the present church, they were without any place of public worship.

The late rector of St. Dunstan's, the Rev. Thomas Snow, anxious to supply this deficiency of church accommodation to this part of his parish, consulted with some of the inhabitants of the Liberty upon the subject, who manifested a desire to aid him as far as they were able in his laudable object. A committee was accordingly formed, whose first effort was directed to obtaining a site for the intended church. In so limited and crowded a district this was no easy task, and it was not until after much difficulty they were enabled to procure the one upon which the church stands. Although not so desirable a situation as could be wished, it is hoped that the time is not far distant when a thoroughfare will be opened through Bream's Buildings, in a line with Stonecutter Street, into Farringdon Street, which would be the means not only of relieving Fleet Street of much of its heavy traffic, but likewise open an almost level line of street, by which Holborn Hill might be entirely avoided. The site being procured, the Rev. Mr. Snow applied to the trustees of Miss Catherine Elizabeth Hyndman's Bounty for assistance, and obtained from them a grant of £3000 towards the building; this grant the trustees afterwards increased to £3400, and endowed the church with £1000, by virtue of which the appointment of the minister rests with them. The remaining funds were obtained from private subscriptions, and a donation of £300 from her Majesty's Commissioners of Woods and Forests, who possess considerable property in the Liberty.

The site of the ground chosen for the erection of the church extends from the north side of Bream's Buildings into White's Alley, taking in the whole of the houses in Three Crown Court†, which formed a *cul de sac* nearly in the centre of the plot, running parallel with the line of frontage in Bream's Buildings. The church occupies a rectangular space of about 56 × 67 feet, with a wing addition, eastward, of about 28 × 15, for a vestry and waiting room, with beadles' apartments above, &c., and cellars beneath. The old buildings having been disposed of by auction, several eminent builders were applied to for tenders for the new building, (the quantities having been previously taken by Mr. Wallen, on the part of the contractors, and by Mr. Skyring on the part of the joint architects, Mr. C. Davy, of 3, Furnival's Inn, and Mr. J. Johnson, of Cook's Court). The tender of Mr. Young, builder, of Eagle Street, Red Lion Square, having been accepted, the works were commenced on the 16th May, 1841. The architects' specification directed that the excavation for the necessary trenches, &c., should extend to the depth of the diluvial gravel, which was found to be as follows:

* The Liberty of the Rolls is both tithe-free, and extra-parochial; it also possesses the singular privilege of exemption from the Sheriff of Middlesex or other civil officers, except by leave of the Master of the Rolls. From a very early date it forms a conspicuous feature in the history of London, and we find that the Third Henry endowed a conventual house here for converted Jews to reside in, bearing the title of *Domus Conversorum*, with the yearly revenue of 700 marks, besides forfeited possessions, which were given over to their use. They lived under a learned Christian, who was appointed to instruct and govern them.

A vast augmentation to their living was made in 1279 by Edward I., who bestowed upon the inmates of the *Domus* one half the effects seized from two hundred and eighty knavish Jews, executed for the evil practices of clipping the coin of the realm: the other half was appropriated to the friars or preachers, to increase their zeal in converting the unbelievers.

In the 18th year of Edward the Third the Jews were universally expelled the kingdom; and in consequence of this fierce act of bigotry, the house of converts, which had been declining, fell into entire neglect, though there were some residents as late as 1377, in which year a mandate from the sovereign dissolved the whole fraternity, and appointed their residence to be a receptacle for certain of the records of the kingdom, from which circumstance the present name is derived.

The first Master of the Rolls, or *Custos Rotulorum*, was William Burstal, clerk, and it was usual in ancient times to select the masters from the church, and often they were the king's chaplains. The first layman who filled the office was the unfortunate Thomas Cromwell, Earl of Essex. The situation is one of high rank, and follows in precedence that of the Chief Justice of the King's Bench. The Master has his chaplain and a reader, who perform service once every Sunday from the 1st Seal in November Term till the last Seal in Trinity Term, in his private chapel in the Rolls Yard. This structure, which adjoins the Master's house, where he holds his court, and which, till lately was his town residence, is well worthy the inspection of the lover of antiquity. It was built from the design of Inigo Jones, at an expense of £2000, and was consecrated by George Mounteigne, Bishop of London, on which occasion the celebrated divine and poet Doctor Donne preached the sermon.

In the chapel there are some fine specimens of stained glass, besides many monuments commemorative of the Masters. The one by Torregiano to the memory of John Tonge, LL.D., Master of the Rolls, is cleverly designed and finely executed.

In the Liberty, excepted from the charter of the *Domus Conversorum*, Henry III. granted the garden grounds of one John Heberden to build a palatial edifice for the Bishop of Chichester; the site where the prelate's residence stood now forms Chichester Rents and Bishop's Court.

Within the Liberty, and still remembered by living inhabitants, stood the Old Six Clerks' Office, once the dwelling of the Abbot of Norton, in Lincolnshire, and afterwards of Andrew Herefleet, from whom it was purchased by John Riderminster, Esq., one of the Six Clerks, who presented it as an office or residence for them to transact their business in; it was called "*Riderminster's Inn*," says Carter, "and was more properly to be called an Inn of Chancery than any of the rest." Tradition has long fixed the range of old buildings standing in Chancery Lane, from White's Alley to Hammond's Auction-rooms, and known as the Red House, as one of the dwellings belonging to the Protector Cromwell.

The Liberty in the year 1708 contained 188 houses, and its boundary commenced, says Hughson, "at the corner of Cursitor Street, next to Chancery Lane, taking in the Rose wine vaults, where it crosses into White's Alley, which it wholly takes in, except two or three houses on each side next Fetter Lane, and there it crosses into the Rolls Garden, which it likewise encloses; it crosses to Bell Yard, which it takes in almost to Fleet Street, except a few houses on the back of Crown Court, which is in the City Liberty. It then runs across the houses to Shire Lane, taking in all the east side, and again crossing over to Lincoln's Inn New Square, runs to the pump at the corner of the Garden, whence it crosses to where it commenced at Cursitor Street."

† The former entrance to this court is now occupied as a back entrance to the vestry room.

From the level of White's Alley, except where there were cellars,

Made earth, &c.	8 . 6
Maiden or yellow clay and sand	1 . 6
Feet	10 . 0

The number of small tenements that previously occupied the site had no drainage whatever, but were supplied with cess-pools, causing considerable annoyance, and extra expense in preparing the necessary foundations. The steining of these cavities was not removed, but were, with the trenches, filled with good concrete, the former being brought up to the level of the latter, which was specified to be of the depth of 3 feet. The depth of the concrete to the front wall of the building, also varies considerably, in consequence of the excavators coming upon the site of an old saw pit, from which a great quantity of rubbish was taken. From other parts of the ground (which appears to have been used as a slaughter-house), considerable quantities of bones and horns were removed.

DESCRIPTION OF MATERIALS EMPLOYED IN THE ERECTION OF THE CHURCH.

1. Stock brick-work, with all arches turned in cement.
2. Strong hoop-iron bound in 3 parallel rows, set throughout in two courses of cement above and below the bond.
3. Bath stone dressings for doors and corbels, columns, &c., and caps and bases to small columns in interior.
4. Corbels and springing stones for columns to interior, of Bramley Fell and Heddon stone.
5. Bell turret entirely of Whitby stone, (Aislaby A).
6. Roman cement to arched dressings of doorways and external parapets or copings.

The front is faced with Suffolk bricks.

The columns supporting the clerestory are built of brick in cement, cross bonded in each course, and are raised upon stone bases and brick piers built from the foundation to the height of the pewing. The timber is fir and oak.* The architectural character of the building is Anglo-Norman; the interior consists of a nave and two aisles, chiefly lighted from a lofty clerestory, supported by round arches and columns. The Communion end is decorated with a series of columns and interlaced arches, the intercolumns containing the Decalogue, in plain gold letters, above which is a series of plain semi-circular arches and columns, with a spacious triple-light window. The principal elevation in Bream's Buildings displays three doorways with stone columns, a large triple-light window, and the central portion of the composition is surmounted by a bell turret, selected from one of an early date, and of a very original character. The church was opened for consecration on Wednesday, the 13th July, 1842, by the Lord Bishop of London, attended by a body of the clergy, &c. After the service his Lordship &c. attended an elegant *déjeuner* in an adjoining building, and previous to his departure was pleased to observe that the ecclesiastical character of the building, together with its capabilities for light and sound, met with his entire approbation.

The cost of the building and vestry room (exclusive of the purchase of the ground from the Bishop of Chichester), was £4275 15*s.* 4*d.*, with a subsequent addition of a £300 contract for the organ. The church is furnished with a gallery on three of its sides, and is calculated to contain 730 sittings. The following are the dimensions:—

Height of nave 42 feet to under side of tie beams.

Width of ditto between between the clerestory walls about 24 feet.

Height of side aisles about 26 feet from paving to under side of tie beams.

Width of ditto about 12 feet.

The head room under and above the galleries 10 feet.

All the timbers are exposed.

The church is warmed by two Olmstead stoves, and lighted by the Bude light.

The following are the quantities of the chief materials:—

Quantity of bricks used, 392,900.

Memel fir, 1675 cube feet.

12ft. 3in. Christiania deals, 74 in number.

12ft. 2½in. Norway battens, 60 in number.

1083ft. of Newcastle crown glass = 5¼ cwt.

The organ for the church, now erecting by Messrs. Lincoln and Son, is 18 ft. high, 11 ft. wide, and 7 ft. deep. It will have two rows of keys or manuals, and two octaves, besides two notes of German pedals, and three composition pedals.

* The pew fittings in the body of the church are chiefly of oak, and originally formed the pew framing of the Temple church, from which the committee obtained it by purchase of the Benchers, as also the communion table.

IRON AS A MATERIAL FOR SHIP BUILDING, CONSIDERED AS A NATIONAL QUESTION.

We are induced to return to this subject from its important connexion with those great branches of constructive art which depend upon the manufacture of iron in this country. Mr. Grantham* has ably led the way in advocating the general adoption of iron for building all classes of ships, and we cannot contemplate the important change which would be produced by the substitution of iron for wooden ships, without a strong conviction of its national importance, and of its earnest claims upon the attention of the legislature. We have already alluded to the vast extent of forest land occupied by timber growing for the use of the navy, both in this country and her American colonies; and a moment's reflection will not fail to show, that to cut down and remove the forest, and to throw as much woodland as possible under cultivation for the production of grain, would contribute in no small degree to the general benefit of society. We hear occasionally a vast amount of exhortation on the necessity for bringing all the waste lands of Great Britain under cultivation, and we admit that the advocacy of such a subject would do honour to the highest talents, and the most splendid acquirements. But whatever may be said in favour of enterprise on so great a scale, or of individual enterprise, undertaken as parts of so great a result, mankind will ever be found very backward to engage in the projects it comprises, when they see before them on the one hand the positive certainty that considerable capital must be laid out before a return can ever be expected, and on the other hand an uncertainty whether, after this has been done, any return at all adequate to the outlay will ever be realized. Hence it is probable that philanthropists and political economists will long be permitted to raise their voices, to urge their arguments, and to bring in array

* See Review of Mr. Grantham's work on iron ship-building, at page 172 of the Journal.

one powerful reason after another, before landowners will be induced to undertake, on a scale of any extent, the cultivation of the land lying waste in so many parts of the country. But the conversion of wood land into cultivated fields suitable for the growth of corn, depends upon circumstances over which the proprietors of the land are not expected or required to exert the same direct influence, the fact being that, whether they like it or not, and whether they may think proper to oppose or to assist the great movement about to take place, a vast amount of forest land will unquestionably, in the course of a few years, be rendered comparatively unprofitable, as far as the consumption of timber is concerned, and the owner therefore will be thrown upon his resources, to enable him thenceforth to command the same profit and advantages as those which he now derives from the land. Here then we are not asking the land-owner to attack his forests and root up his timber in all directions, and convert the land which it occupies into corn fields and meadows, by way of an experiment whose success is doubtful, but we are simply pointing to a time when, without an effort of his own, this very result must come to pass, unless he is content quietly to sit down with a property greatly depreciated in value. Those, therefore, who are looking forward to the prospect of an amended condition of the country, when it shall produce a greatly increased amount of grain, may contemplate the ultimate success of their expectations with perfect coolness and confidence, since no petty interests, nor any opposition of even extensively combined interests, can avail against a movement so deeply rooted in the very organization of society as that on which depends the substitution of iron for wood. It is true that many circumstances may retard or hasten the movement, according to the view which may be taken of the case by governments and individuals; but however these circumstances may affect the general progress, we hold a confident and well grounded opinion that this progress will be certain and inevitable, although it may be slow or rapid, according to the changes and the influences which move around it.

In addition to the value of the land at present occupied by the growth of timber, to the exclusion of food suitable for men and animals, it should be borne in mind that woodland employs a very insignificant amount of labour in its cultivation, if indeed the few and simple processes connected with the management of growing timber can be called by the name of cultivation. But let this land be converted into arable and pasture, and a considerable amount of labour becomes at once necessary for its cultivation, this in itself forming no trifling consideration at a time when labour is so abundantly in excess of the regular demand for it.

There is, however, a more important view to be taken of the question than any we have hitherto noticed, and this refers to the comparative national advantage of extensive iron and wooden constructions. This part of the question may be first limited to this form :—supposing Great Britain to produce from her own soil all the wood and all the iron necessary for constructions of all kinds, whether is it most to the national advantage to encourage the developement of constructions of wood, or those of iron? Now we apprehend the correct decision of this question depends upon the determination as to which of the two materials employs the greatest amount of labour from the time at which man begins to effect its conversion from the native state, till it is finally wrought into the form or the fabric for which his skill and ingenuity have designed it. Now the native state of wood is in the form of growing timber, and the labour of man commences with the cutting down of the timber, and embraces the various processes afterwards necessary for its complete conversion and adaptation to his use. Also the native state of iron is in the ore deeply imbedded in solid strata, commonly a considerable depth beneath the surface, and the labour of man commences with the extraction of that ore, and continues throughout to be constantly in requisition in every process to which the raw mine is subjected, and in every change which the metal afterwards undergoes until it takes its place in the structure, whether in the shape of a bar, a plate, a nail, a screw, or any other of the numerous forms to which this most useful of the metals has been adapted. The conversion of iron also employs an immense amount of labour in procuring the coal for smelting it.

We shall not attempt, in the present stage of the inquiry, to lay down any general rule as to the comparative cost of iron and wooden erections, because this subject in itself embraces a range which would extend far beyond our limits. It will be sufficient for our present purpose to assume that a given effect can be produced by means of either material for about the same amount of money, and this assumption renders it unnecessary to inquire into the comparative quantities of wood and iron required in any given case to produce the same strength and durability. The main subject for consideration is evidently that of the intrinsic value of the two materials, because it is certain that the one which, in its native state, is most valuable, is at the same time the one requiring least labour to adapt it to building purposes, and *vice versâ*. This may be familiarly illustrated in this way :—Suppose two structures of the same kind to be composed of two separate materials, A and B, and that each costs £1000; suppose the first cost of A to be £700, and that of B £100, then it is evident that the value of the labour employed in A will be £300, and that on B £900. Now these figures are merely given as an illustration in which A may be supposed to represent wood, and B iron; yet it will be seen in the sequel that these proportions are not greatly at variance with those which really obtain.

In attempting first to gain some satisfactory result as to the intrinsic value of timber, we shall not at present enter into the detail of price paid to the merchant for timber in the log, and separate this from the value of the labour required in its conversion, because these prices are often only of local and temporary application, being subject to many variations, both of time and circumstance. We shall therefore consider the question under a more general aspect, and with this intention we shall estimate the value of timber, according to the length of time during which its growth occupies a given quantity of land. The value of this land, or rather the value which it would have yielded if otherwise occupied, will evidently be that value which the timber grown upon it ought to possess at the time when it becomes suitable for conversion to building purposes.

Now in the case of oak timber, it requires a growth of about eighty years; and we learn, on the authority of Mr. Chatfield, of her Majesty's dockyard at Plymouth, that the timber of the Hindostan, a seventy-eight gun ship recently built, would require seventy acres of land for a term of eighty years to be occupied in its growth. Now, supposing this land to be worth only £30 an acre, we must estimate that the whole profits which would otherwise arise in the shape of interest or rental of this land are completely absorbed for eighty years. Now the compound interest of £1 for eighty years, amounts to £23, computing interest at 4 per cent. per annum, a reasonable sum when put in substitution for the rental of land. We have therefore $23 \times 70 \times 30 =$ £48,300, which is a sufficiently moderate estimate of the intrinsic value of timber employed in the Hindostan. The whole cost of the Hindostan was £72,000, from which about £12,000 may be deducted for hemp, guns, powder, and other articles of equipment, leaving £60,000 for the value

of the timber work. Now out of this sum the prime cost of the timber must have been, as we have shown, something like £48,300, leaving only £11,700 for labour, or less than one fifth part of the gross value of the timber work.

Turning now to the case of iron, suppose the same sum of £60,000 expended in the construction of an iron vessel, and we are unable to see what sensible proportion of the whole will be expended otherwise than in labour. Iron has in fact no intrinsic value. Buried far beneath the surface, it neither occupies any of the superficial area of the land, nor interferes with the cultivation of the land which covers it. True it is, that where extensive iron fields are worked, and numerous mills and furnaces are established, the surface of the ground is occupied and rendered otherwise unfit for agricultural purposes. But this occupation is so comparatively insignificant, that it may be almost rejected as an element in the question. Undoubtedly the proprietors of coal and iron works are compelled to become purchasers of the land beneath which their workings extend, but the surface, notwithstanding, is preserved for agricultural purposes, quite independently of the operations which are going on underground. In the mining districts of South Wales the workings always lie beneath the mountains on either side of the valleys. The surface of these mountains is of course of inferior value, and the cinder heaps, as well as the rubbish from the mines, are formed in places where the land is of little consequence. The valleys themselves, comprising the only fertile and really valuable tracts of land, are only occupied by the narrow widths necessary for a railway or a canal, and for the furnaces and other buildings connected with the works; their sides which are not thus taken up being given over to the labours of the husbandman. It is difficult, or indeed impossible, to estimate in a general way the influence exercised by the cost of the land occupied by the iron works in giving an intrinsic value to the iron produced. If we deduct, however, one-tenth from the gross cost of iron work to represent this intrinsic value, we shall undoubtedly be making a very liberal allowance, and this would leave nine-tenths to be expended in labour alone. Hence in a structure amounting to £60,000, where iron is the material employed, we may estimate that £54,000 are expended in labour alone; while in a wooden structure costing the same sum, we have seen that less than £12,000 would be spent in labour.

It is further to be borne in mind, that the whole of the iron which would, or which may, be used as a substitute for wood, is the produce of our own country, whereas most of the timber both for naval purposes and for house building comes from foreign countries.

In attempting to estimate the intrinsic value of the whole of the timber employed in the naval service of this country, we shall revert to the case of the "Hindostan," a vessel of two thousand tons burden, and having found that the prime cost of the timber for this tonnage amounts to £48,300, we shall derive by simple proportion the prime cost of timber required for the whole number of ships annually built in Great Britain. Now the average number of merchant-ships built in Great Britain from 1826 to 1835, was one thousand annually; and we find from Parliamentary returns in 1839, that the gross number of ships registered in the United Kingdom, including steam-boats, amounted to 21,037, with a tonnage of 2,531,005 tons. This gives 120 as the average tonnage of the whole shipping of this country; we shall therefore have 1,000 ships × 120 = 120,000, as the gross tonnage of the ships annually built in Great Britain for the merchant service. To this may be added one-fourth for the annual tonnage of the royal navy, making a gross annual amount of 170,000 tons for the whole navy of the United Kingdom. Then, if the value of timber without labour for 2,000 tons be equal as we have seen to £48,300, the intrinsic value of the timber for 170,000 tons will be £4,105,500. Now we are aware that the whole of this amount of timber is not produced from this country, nor indeed is it ever likely that we could supply so vast a quantity of timber as would amount to this sum annually. But supposing iron ships to become general, the whole of the material used in ship building will be the produce of native resources and industry. The following will give an approximate idea of the benefits which such a change would confer on the labouring industry of the country. On the supposition that the gross value of the iron employed would be the same as that of the timber at present used, and supposing the prime cost of timber to be, as we have shewn in the case of the "Hindostan," four-fifths of its gross value, then the value of iron-work necessary for the shipping of the whole country would be £5,131,875; and supposing the intrinsic value of the iron to be one-tenth of this amount, there remains £4,618,688 to be expended in labour; whereas, at present, the utmost amount paid in labour for building wooden ships would scarcely exceed one million sterling, supposing the whole shipping of the kingdom to be built in this country, which as every one knows is far from being the case. We need not dwell for a moment upon the great boon which would be conferred on the country by the creation of so vast a demand for labour as that which the substitution of iron for wood in ship-building would thus effect. Assuming in round numbers that additional employment of human labour to the extent of three millions and a half sterling (more than the whole amount of poor-rates in England and Wales), would in this way be called for, it would furnish constant employment to more than 70,000 persons, and afford the means of support, taking an average of five in each family, to about 350,000 souls. This is certainly a consideration of national importance, and when in addition we consider the agricultural value of the land at present occupied in growing timber, the case in favour of iron becomes much stronger. Taking the average durability of wooden ships at twenty years, which is probably too long a term, considering the liability to loss by wreck, a ship equal in size to the "Hindostan" will require 280 acres of land to be constantly growing timber, in order that one may be built as soon as her predecessor becomes unfit for service. Proceeding on the same data, we find that to keep the whole shipping of the United Kingdom afloat, it is required that 354,340 acres of land, or 550 square miles, shall be constantly planted with timber.* This extent of territory, on a moderate estimation, would, if thrown under cultivation, afford subsistence to more than 137,500 souls.

The comparative safety of iron and wooden vessels forms a subject of scarcely inferior importance in a national point of view. Now the advantage which iron ships possess over those of wood in this respect will be evident, when we consider how effectually the danger both from fire and water is obviated by the introduction of water-tight bulkheads. The introduction of these into iron ships is calculated to add greatly to their security when by any accident a part of the vessel is stove in, because, if the water should rise in any one compartment, the water-tight bulkheads separating this compartment from the rest of the vessel, effectually confine the water to that particular place. Hence it is found that the effect

* Mr. Grantham estimates that 400,000 acres are required to grow the timber for the ships annually built for this country and the colonies.

even of the most serious leak in an iron ship causes her only to sink a few inches in the water, whilst a leak of the same kind occurring in a wooden ship would probably baffle all the power of the pumps and the resources of the carpenter in the endeavour to keep her from filling and going to the bottom. Numerous experiments have been tried with iron ships on the effect of inundating any particular compartment, and the results have been highly satisfactory, as shewing the comparative innocence of an ordinary leak in any part of the bottom or sides. Instances are on record also in which iron ships have been stove in by collision, and so trifling has been the consequence, that they have been able to pursue their voyage almost unimpeded. The following may be cited:—On the 7th of November, 1837, a collision of a most violent character took place between the "Royal William" and the "Tagus" near the Isle of Wight. "The former vessel, which was fitted with water-tight bulkheads, was stove in with great violence on the starboard bow, and the water immediately rushed *into the section before the engine-room.*

"When the alarm was over the carpenter went under the bow in a boat and covered the breach with planks and tarpaulin. In this condition she steamed to Plymouth, where some extra fastenings were applied; after which she finished her voyage to Dublin, and then crossed to Liverpool with the temporary covering."

Now it is in iron ships alone that the division into compartments by means of bulkheads can be effectually and securely made. In these they give additional strength and almost perfect security.

The loss of life in steam vessels alone in our own seas from 1817 to 1839, appears to have amounted to 570 persons, and that in American steam vessels on their rivers and seas to about 1,700 for the same period. It may be safely asserted, that if these ships had been of iron, and divided into compartments as usual in iron ships, this serious loss of life would have been greatly diminished. Iron bulkheads are as effectual in preventing the spread of fire as of water, and the security which they are thus calculated to afford to property as well as to life should by no means be overlooked in considering them as a national question. Let any unprejudiced person now review the positive and probable advantages of generally introducing iron ships into every branch of our navy, and he cannot fail to be struck with the immense superiority they are calculated to realise over the whole system of ship building as now practised. An unprecedented impetus to be given to the manufacture of a native article which we supply to most other countries—A certain conversion of many thousand acres of land, now unprofitably employed in growing timber, into land capable of supporting men and animals—A vast creation of permanent national wealth, by increasing the value of land now occupied as woods and forests—An extent of employment for our starving population, calculated to diminish the whole poor-rates of the country to about two-thirds of their present amount, and to keep annually many thousands of industrious and deserving labourers from the clutches of the emigration agent—A saving of life and property to an almost incalculable extent—Facilities for extending steam navigation over every sea, and to every part of the earth—these are a few of the national benefits which this question opens to our view; and considering how real and substantial these benefits are, and how certain is the prospect of achieving them, we shall confidently hope and expect to see the advocates of iron ships go on in their successful triumph over the rooted prejudice of centuries, goaded on as it is by the dark malice and jealousy of bigoted self-interest.

LITHOLOGY, OR OBSERVATIONS ON STONE FOR BUILDING, BY C. H. SMITH.

(FROM THE TRANSACTIONS OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.)

(*Continued from page* 248.)

THE greater part of Westminster Abbey was formerly built with stone brought from quarries at Godstone, from which circumstance that village is said to have derived its name. Sir Christopher Wren, in alluding to the repairs of the Abbey, describes the stone work as having mouldered away 4 inches deep from the original surface: he repaired the parts most decayed with stone brought down the river from near Burford, in Oxfordshire. A specimen of this reparation may be seen on the exterior of the north transept, and on the north side of the choir, as far as Henry the Seventh's Chapel. Ryegate stone was not entirely out of use in the time of James the First, for Inigo Jones introduced it in part of the front of Whitehall.

While both Caen and Ryegate stones were in general use for ornamental architecture, large quantities of hard grey limestone, generally known by the name of Kentish Rag, were brought to London by water, from the neighbourhood of Maidstone, and extensively used for ruder purposes. The basement, or plinth, next the ground, of Henry the Seventh's Chapel, at Westminster, is formed of this stone; and large masses of wall, of the same material, have been found in digging the foundations for the New Houses of Parliament.

About this time, or soon after the year 1600, Portland became the general stone used for superior buildings in London and the South of England; but as I intend to devote more time to that material than any other, I propose leaving it for the present, and now proceed to describe the sandstones generally.

It is not my intention to attempt a description of the various qualities and adaptations of granite, further than to allude briefly to the cause and result of its decomposition.

In the order of creation, granite is decidedly among the oldest formations; it may be considered as the father of most other rocks, especially of the numerous varieties of sandstone. Granite is generally composed of coarse grains or crystals, of so hard and refractory a nature, as to render it only suitable for those bold massive structures which have scarcely any embellishment. It may be considered good and durable in proportion to the fineness of the component parts, and especially in proportion to the abundance of quartz, and scarcity of felspar. In Cornwall, and part of Devonshire, the granite is remarkable for the super-abundance of well-defined and large crystals of white felspar which it contains; and this is the reason why the granite from those countries is less durable than the Aberdeen, or Guernsey, in which there is comparatively little felspar in proportion to the quantity of quartz and mica. At the Earl of Morley's quarries, in the vicinity of Prince Town, Dartmoor, the granite is more or less decomposed to the depth of fifty or sixty feet, and this surface granite has been used in almost all cases, because it may be obtained at the cheapest rate: the result is, that in all buildings which have stood for a number of years, such as the Dartmoor Prison, each block of granite has become a porous mass, absorbing moisture continually, rusting the iron bars employed in combination with it, and rendering the cells

so damp that they can only be used by covering the walls, both inside and outside, with Roman cement and tiles. This defect is observable in all the granite which is not quarried from a depth below the influence of decomposition.

Felspar is a compound body, in which certain alkaline substances always form a predominant ingredient, rendering it extremely liable to decomposition, especially if it be exposed to the atmosphere in a damp or wet situation. While this process is going on, the lustre of the felspar is gradually diminished, its colour is altered, its hardness and cohesion is destroyed, until at length the mass is completely changed into some kind of clay, fit for pottery. Another reason why the granite of Cornwall decomposes so readily, is, that its felspar contains an unusually large proportion of alkaline matter, which always has a great affinity for moisture. A few miles north of Plymouth the surface of the country, over hundreds of acres, is covered with decomposed felspar in a state resembling flour, produced from this description of granite: it is purified by passing streams of water over it, and when prepared and baked as usual in the manufacture of china, it forms a beautiful porcelain. Specimens, shewing the natural and artificial gradations of the decomposing granite, felspar, clay, and porcelain prepared from it, may be seen at the Museum of Economic Geology, in Craig's Court, Charing Cross. In granite rocks felspar is generally more abundant than either quartz or mica; consequently, if it be removed by the means which I have described, a rapid disintegration of the remaining portions must readily take place, leaving the siliceous sand, mixed with certain quantities of mica, entirely separated from the clay and alkaline salts of the decomposed felspar. If sufficient time be allowed, the sand will ultimately become indurated into compact sandstone. This process of decomposition and partial induration must have gone on to an enormous extent, and continued through a vast period of ages, in order to have produced all the sandstone rocks which now constitute so large a portion of the earth's surface.

All rocks appear to have been formed either entirely under water, or by frequent alternations of wet and dry. Sandstones frequently present a laminated structure, as if by the overflow and recession of the tides, which constantly left a sandy sediment with minute plates of mica from the decomposed granite. These plates being thin, compared with their size, are almost invariably found with their flat surfaces parallel to the lamination, thus indicating most distinctly the bed-way of a stone by their presenting a spangled or glittering appearance when viewed in a direction to reflect the light, an effect not to be met with on viewing a surface across the strata. The extreme tenuity and elasticity of the plates into which mica may be divided with the greatest ease, and the situation of the plates generally parallel to each other, will somewhat account for the readiness with which micaceous stones peel off in thin sheets. The material so extensively used in London, especially for foot pavements, popularly known by the general term "Yorkshire Stone," will serve to illustrate these remarks. If a stone that is evidently laminated be placed in an exposed situation, with the planes of lamination parallel to the outward surface of a building, it will exfoliate or decompose in flakes according to the thickness of the laminæ, whereas, if the same stone were placed so that the planes of lamination be horizontal, that is, most commonly on its natural bed, the amount of decomposition will be comparatively immaterial.

Some of the sandstones are irregularly laminated, presenting an appearance across the strata of a number of short black lines, arising from small quantities of carbonaceous matter being interspersed in beds often parallel to each other, as in Craigleith bed-rock, but occasionally as if formed by a succession of minute undulations, similar to rippled markings of agitated shallow water upon sand. The stone from Garscube, or President quarry, near Glasgow, is of this description.

Many sandstones are composed of small pebbles, varying considerably in appearance, and often essentially different in their elementary character. These are coarsely conglomerated together, so as to form a sort of pudding-stone or indurated gravel, of which Bramley Fell, especially the coarse-grained variety, is a good example. If these various substances be exposed to the same causes of decomposition, they will resist them unequally: those parts of the stone which decompose most readily being removed, leave the durable portions exposed, so as to be more easily affected by mechanical forces, such as the freezing and expanding of water after being absorbed by the pores of the stone, occasioning a disruption of the external particles. A constant succession of these chemical and mechanical operations will disintegrate a mass of stone composed of various substances in much less time than if the same bulk were formed of one uniform homogeneous material, even if that one material were the most decomposed portion of the conglomerate to which I have just alluded.

After having examined the component parts of a stone, the next consideration must be, the condition of those parts to form the aggregate. In all specimens of genuine sandstone the grains are infinitely more durable than the cement which unites them, and in some cases, notwithstanding the cement is of the best quality, it may be so scantily supplied that the grains are scarcely attached to each other: consequently such stone must be extremely friable, and will suffer from all kinds of mechanical forces. The greatest portion of the mass of all sandstones is made up of quartz or siliceous grains. If the substance that cements the grains together be also siliceous, the stone will most probably be very durable, but we frequently find siliceous grains cemented with argillaceous, calcareous, ferruginous, or other matters, each of which has more or less affinity for the silica, and of course the grains are more or less firmly attached to each other.

Those cements which partake most of the character of iron or clay are most likely to separate from the grains of quartz: consequently a sandstone thus compounded will, in all probability, soon yield to atmospheric influences, because the oxygen of the atmosphere produces considerable alteration in stone containing much iron, under which circumstances it is generally reduced from a hard and refractory to a soft and crumbling substance. If the component parts of a stone be siliceous, with a calcareous cement, there is good reason to believe that such a substance will stand the weather tolerably well, for it may be considered the natural product of which human ingenuity has from a very remote period successfully formed an imitation, in the commonest of all building materials, mortar.

A defect to which all the sandstones are liable is, that a portion of uncrystalized carbonaceous, ochrey, or earthy powder, sometimes nearly fills the interstices between the crystals, occasionally forming what are called "clay balls," and often lying between the laminations. These are always injurious to the durability of a stone, especially if they amount to any considerable quantity.

In sandstone quarries, except the uppermost strata, there is very seldom any material difference between the numerous beds, as regards their qualities of withstanding the weather. The quarries

belonging to the Duke of Devonshire, by the side of the river Derwent, in Derbyshire, have a depth of workable stone of at least 40 feet, in eight or ten beds, all as nearly as possible of the same quality. The numerous quarries in the neighbourhood of Leeds and Huddersfield have many beds in the thickness of about 50 feet, some of them coarser in grain than the rest, but no essential difference in durability has been noticed. The same remarks will apply to the sandstone quarries about Dundee, Edinburgh, and Glasgow, especially to the celebrated quarry at Craigleigh, which was originally a hill about 100 feet high, but where there is now an excavation not less than 100 feet below the surface of the ground, and the proprietors have ascertained by boring that the same kind of stone is to be found considerably deeper. Here then we have an instance of between 200 and 300 feet of stone in about 200 beds, all of the same quality. Lenticular masses of liver rock are occasionally found, but their occurrence is quite uncertain. No difference in durability has been discovered in any of the beds or masses, except that the bed rock will flake off if placed vertically in an exposed situation, a defect common to all beddy stones, whereas the liver rock is equally durable, or nearly so, in whatever position it may be fixed.

There is one peculiarity in the sandstones, which I think highly deserving notice, and that is, the labour of converting them to useful, or more especially to decorative purposes. Architectural ornaments, whether mouldings, carvings, or other decorations required to be well executed, particularly if on a small scale, will unavoidably occupy much time if carved in sandstone, on account of the nature of the material, which is so destructive to edge tools. In confirmation of this assertion, it is necessary to remark that the only material for sharpening edge tools is sandstone, either as a hone or turkey stone, used by joiners and cabinet makers, grind-stone, scythe-stone, and many more, all of which are of a sharp sandy texture. Therefore it is easy to conceive, that the same kind of stone which is experimentally found to sharpen tools most expeditiously, will also be the readiest to destroy their cutting edge, and thereby not only retard the progress of the workman, but occupy his time in frequently re-sharpening them. Quartz is one of the hardest substances in nature, much harder than steel; therefore, instead of the chisel's cutting the stone, the stone cuts the chisel, and a portion of the steel is left upon the stone after every blow. The actual effect of the tools on sandstone, is to force the grains to separate from each other by concussion, for it is impossible to cut a hard substance with a comparatively soft instrument.

Stone that is to be used at a distance from the quarry cannot be profitably applied to architectural works, unless capable of being sawed with facility, as experience teaches us that it is cheaper to have blocks larger than necessary, and run the risk of damage in loading and unloading, than to take more time and care to prevent such mischief, the value of the cubic contents of the stone that is thus wasted being less than that of the time which would be occupied in packing it with greater care. If the blocks can be reduced to the requisite dimensions by sawing at a moderate expense, the saving will be considerable, as the sawed pieces are nearly fit to pass as finished for "plain work," and the surplus pieces serve for ashlar, paving, &c. But should the expense of sawing be so great as to render it unadvisable to proceed in this way, then the blocks must be roughed out at the quay, and left a few inches larger than required, on account of the damage likely to occur on board ship, and in various removals to their final destination; the plain surface must then be worked off by manual labour, and the surplus stone which is chipped off will be merely rubbish, after having paid for its freight, cranage, cartage, and many other expences. The sandstones are all expensive to saw, on account of the hardness of their component parts, and the excessive wear and tear of the saw-plate: this I have ascertained from my own experience. The Craighleigh stone, which deserves to be classed among the best of the sandstones, costs nearly four times as much to saw as Portland stone.

It is important in many respects, whether the component parts of sandstone be fine or coarse. Some kinds are composed of such large particles as to be directly visible to the naked eye at the distance of several feet. The coarsest of Bramley Fell, and of other millstone grits from the vicinity of Leeds, are examples of this description; other varieties of sandstone are so finely grained, as to require a microscope of considerable power to distinguish their structure. Should two specimens be exposed to precisely the same atmospheric influences, and all other conditions be equal, the coarse-grained would certainly be the first to decompose. Among the numerous sandstone buildings in this country, those which have been constructed with a fine-grained stone are usually in the best state of preservation, and it may generally be considered as a sort of rule, that the same description of work can be performed in less time if the stone be fine-grained than if it be coarse.

Particular cases may come under an architect's consideration, wherein the specific gravity or weight of stone is of serious importance, such as landing places, or steps occasionally under water, where there may be a rapid current, or in other situations subject to the influence of powerful waves, especially of sea water. Such circumstances will require that a heavy stone should be used, because all bodies immersed are reduced in weight precisely equal to that of the bulk of water which they displace. The lightest stone I have ever found, is from Gatton, in Surrey, weighing 103lb. to the cubic foot. Now if similar stone were used in water, it would be reduced 63lb., the weight of a cubic foot of water, therefore it would be like building on land with a material weighing only about 40lb. to a foot. The heaviest building stones that have yet come within my notice, are the dark grey varieties of sandstone, from the vicinity of Swansea, Glamorganshire; Abercarne, Monmouthshire; the Forest of Dean, Gloucestershire; and the neighbourhood of Dundee, some of which are even heavier than granite, and I think quite as durable, weighing upwards of 170lb. per cubic foot. Hence you will immediately perceive that such stones are peculiarly well-adapted for docks, harbours, breakwaters, bridges, and to all purposes where the violent commotion of water is to be contended with. In situations constantly or alternately under sea-water, sandstone is preferable to limestone, because it is not so liable to be perforated by the Saxicava rugosa, the Pholas, or other boring mollusca, which frequently honeycomb calcareous stones within their reach to the depth of several inches.

It is not very likely that a well-developed oolite would be taken for a sandstone, but I think it extremely probable that a casual observer might mistake some of the highly crystalline limestones for sandstones, and a very fine-grained sandstone might just as likely be taken for a limestone. The more scientific method of detecting the difference is to test them with an acid: diluted muriatic acid is perhaps the best, but this is not a very agreeable fluid to carry in the pocket, and not always to be obtained conveniently, and if it were, some of the beautiful crystallized magnesian limestones are at first so amazingly slow in their progress of effervescence, that an inexperienced person might decide erroneously

without waiting for the actual result. The method most convenient on all occasions, and which I am inclined to believe will rarely, if ever, lead to false conclusions, is to try if the specimen will scratch glass with a slight pressure of the hand: common crown glass is better for this purpose than any other, and if it makes a mark that cannot be wiped off with the finger, there is no doubt of the sample being a sandstone, composed chiefly of quartz or silicious grains. There are, I admit, other substances that will scratch glass, such as diamonds, rubies, and most of the precious stones, but these are never found in enormous masses: chert or flint will also do the same, but no one would test such materials under an impression that they might be sandstone, their appearance alone being a sufficient proof. The method I have proposed is only intended for such stones as, by their resemblance to others, might probably lead to erroneous conclusions.

(To be continued.)

ELECTRICITY.—EFFECTS OF LIGHTNING.

TO THE EDITOR.

SIR,

FROM the subtile nature of the electric fluid there is little probability of its constitution and properties being perfectly understood, except as they are made evident by its effects on matter. Considering the numerous theories which have been invented to account for and to explain its effects, I am surprised that I have met with so little in relation to the mode in which these powerful effects are produced on buildings and ponderous masses of matter. I cannot hope, therefore, to render a satisfactory view of the manner in which this agent produces its instantaneous work of destruction; but hoping that it may lead others more competent to the discussion of the subject, I shall state those opinions which I think most confirmed by the phenomena. The popular notion, and indeed the general idea, seems to be that of mechanical force existing in the electric fluid; hence we have the common expression, "Struck by lightning," intimating that the effect is produced as if struck by a cannon-ball or some other external force. It is a well-known fact, that however highly a Leyden jar or any other electric reservoir may be charged, there is no sensible increase of weight; yet the charge when concentrated is capable of effecting on a limited scale all the phenomena of lightning. But how force, mechanically considered, can be exerted by an agent having no sensible weight, must certainly be difficult to conceive, if not impossible in the nature of things. If, then, the weight of the greatest accumulation of electricity we can obtain be insensible, no estimable amount of velocity which it could have would appear sufficient to move those ponderous masses of matter which are often disturbed by its agency. Stones supporting a heavy superstructure, and firmly held by the cohesive power of mortar, are moved from their places by forces acting apparently on a small surface, and no such effect could be produced in a limited space, except by a force equal to many tons. It follows further from the subtile nature of the fluid, that mechanical force could not be much exerted by it while it pervades with such perfect facility even such dense forms of matter as gold and platina. There are evident analogies between light, heat, and electricity, and we might expect to find some similarity in their effects, but on the supposition of electricity exerting force mechanically we find none, as even the eye—the most sensible of our organs—does not furnish us with such an idea.

Now, if electricity could exert such force, the discharge on the arm of a balance would be a direct means of measuring its power, but as effects do not appear to result from it in this way, such as from air in motion, I conclude we cannot conceive it capable of exerting a direct mechanical force on matter. But while light and heat supply us with no analogies of a mechanical character, they both furnish—especially the latter—abundance of those which are considered as chemical agencies. Those alterations of volume which take place in matter when pervaded by heat, in some instances bear a striking resemblance to those produced by electricity. When chemical combinations or decompositions are effected by the agency of heat, it is a well-known fact that the alterations of volume in some instances are so great, and produced with such instantaneous violence, as to suggest at once the operation of some agent similar to electricity. Now electricity is known to be the most powerful agent in nature, effecting the decomposition of substances which had shewn themselves quite refractory under the influence of all other agencies. Employing the voltaic electricity, Sir H. Davy made his most brilliant discoveries by the fluid collected from a few hundred square inches of surface. The tension of electricity so collected must be exceedingly feeble compared with that derived from many hundred square miles of cloud, and the energies of their powers are quite proportionate; the fluid, in the one case, fusing a fine wire or a lamina of metal, and in the other, being capable of melting considerable bars of iron. When we consider, then, the quantity and tension of the electricity which is furnished by the great laboratory of nature, we need not be surprised at the magnitude of its power, considering what has been done with that furnished by the ordinary machine or the voltaic battery. It appears highly probable that the electric fluid contains neither light nor heat in itself, but that these, like the ordinary light and heat of fires, are derived from combustion. From the numerous experiments that have been made on electric light, its colour appears intimately connected with the constituents of the medium which it traverses. It is a known fact that the intensity of combustion varies the colours of light as well as the combustion of different substances; for instance, the combustion of sulphur at a low temperature gives a blue light; at a high temperature, a white one. If the electric fluid had any proper light, it might be expected to be generally of the same colour, but that from the ordinary machine is blue, and that from lightning is white or reddish white. Dr. Fusinieri states, that "the electric spark which issues from a metal into air contains a group of molecules, the most central of which are in a state of simple fusion, and the exterior ones are in a state of greater or less combustion from their contact with oxygen, according as the metal is more or less oxidizable, and the matter thus contained in the spark *is endowed with a force of spontaneous expansion.*" Dr. Fusinieri also observed, that when the electric spark passed through different kinds of metal nearly in contact, there is a mutual transposition of the metals so traversed by the fluid. Suppose, for instance, the course of the spark to be from gold to silver, a film of gold is carried to the silver, and a film of silver to the gold; it should be particularly observed the last transposition was contrary to the course of the fluid. These films of metal were transported in a state of fusion, and spread so thinly as to be soon evaporated. By chemical tests, and otherwise, on the surfaces of trees split by lightning, minute portions have been discovered of ferruginous and sulphureous substances deposited in a state of fusion, and these depositions were also recognised on houses which had

been traversed by the electric fluid. From the great importance and intimate connection of Dr. Fucinieri's conclusions with this subject of buildings struck by lightning, I am induced to copy them, for I believe he is almost the only person who has written any thing bearing on this branch of practical electricity. "1st. The electric spark is not formed by a pure fluid, or by any imponderable fluid. 2nd. The heat and light of the spark proceed from the ignition and combustion of the particles of ponderable matter. 3rd. The presence of air produces on the spark two distinct effects, the one to hinder its free expansion in space, the other, by supplying oxygen, to promote the combustion of the exterior molecules of the group, while the central molecules are luminous from ignition and fusion alone. 4th. In gases without oxygen the material molecules which compose the spark ought to be simply in a state of incandescence and fusion, without any combustion of the exterior particles of the group, in the same manner as this takes place for the central parts of the spark in common air. 5th. In gases deprived of oxygen, as well as in a vacuum, the molecules which compose the spark ought to be incandescent, that is, in a state which fits them to emit light and heat, a phenomenon of the same kind as those inflammations which chemical experiments prove to take place without the aid of oxygen in so great a number of other combinations, or even without there being any new combination, by the sole effect of division." The inferences then are, 1st. That the electric spark consists, like all other flame, of incandescent molecules. 2nd. That in traversing solid matter in large quantities it decomposes portions which, expanding with forces similar to those of gunpowder, are fully competent to shatter to fragments the most solid matter. This is the entire substance of all that I contend for; and, considering the great decomposing agency of the electric fluid, I cannot conceive it possible that substances containing numerous constituents capable of enlargement by ordinary heat, can resist being broken to fragments when pervaded by the electric fluid. We know that numerous substances have the property of decrepitating by heat, amongst which slaty coal is familiar to every one. Now this effect results from a portion of the substance being rendered gaseous by heat, which expanding, forces the parts asunder with a slight detonation; and the reason why all substances do not explode in the same way is because their constituents are not expansible by heat.

Now supposing the truth of these remarks should be confirmed by future inquiry and experience, their practical application would point to a mode of construction in which the exposed parts of buildings should be composed of materials incapable of enlargement by the electric fluid. The subject here embraces an extensive field of inquiry, rendering necessary an acquaintance with the habitudes of the electric fluid, and the various combinations of ponderable matter, and requires positive answers to the following questions: 1st. Are all building materials equally liable to destruction by its influence? 2nd. If some are less liable than others, what are their constituents, and how combined? It must be admitted, however, that until the fundamental principle of this subject is fully and satisfactorily proved, or admitted, it would be futile to proceed far with the consideration of the preceding questions, as it would be theorizing without a practical basis. The fundamental inquiry is this,—whether the destruction of buildings by the electric fluid be effected by chemical or mechanical agency, or both, or neither. If the destruction be effected chemically we may probably, from the varied habitudes of electricity with different kinds of matter, select such combinations of material elements as shall be uninjured by its influence. If its destructive powers be exerted, either mechanically, or in some unknown or undiscoverable way, we must endeavour as we have hitherto done to pass it, quietly if possible, to a more spacious residence in the interior of the earth. The facts observed by Fucinieri merit a little further notice. And first, of the mutual transpositions of the metals through which the electric fluid passed, particularly that which took place in a direction contrary to the course of the fluid. When portions of the metals become fused, and their volume enlarged, they must fly off on that side which offers the least resistance, and this shows in how small a degree these molecules were resisted by the movement of the electric fluid, fully proving, I think, that expansive force alone gave them motion. Now if this effect took place in substances less cohesive than metals, violent fracture must have followed. In relation to his observations and inferences as to the nature of the electric spark, I think it improbable that ponderable matter could be transported with that extreme velocity which characterises the motion of electricity, and particularly through a resisting medium like air; because we know that for distances of a few miles its change of place is instantaneous.

The effects of combustion and incandescence are due to the momentary presence of the electric fluid in each portion of its path. And this consideration, if correct, shows in a most striking manner the heating power of this fluid, for if it can bring to a state of incandescence the air, or any gas through which it passes, by its momentary presence, its power to generate heat must be exceedingly great. And that this is the case will appear, I think, from two reasons: First, The volume of the spark would be liable to increase as the distance traversed was greater; but we do not observe this to be the case; and, second, in the ordinary machine the spark is formed at the very point where it leaves the conductor. Now, as the electric spark is incandescent matter, I infer that its incandescence is the effect of the momentary presence of the fluid in each portion of its track, and not the motion of incandescent matter. If these considerations have any weight, it would be impossible for some kinds of solid matter to be traversed by the fluid, if in considerable quantity, without undergoing changes of volume.

It is of little importance to this subject what theory of the fluid or gaseous states of matter may be true,—it is sufficient that it is reducible to these states by electricity. Now, in relation to the habitudes of electricity with matter, it is unnecessary to say much, but perhaps some observation may be useful. Has every species o. tree been equally injured by lightning? Out of thousands of acres which I have seen planted with fir, I do not recollect to have seen or heard of one tree being injured by it. Of course, before inferences of any value could be drawn from this, it would be necessary to be assured that this had not been found to be the case in any place. But from its resinous composition in the green state, we might in some degree expect this species of trees to be exempt from injury, considering the non-conducting nature of resinous substances. This substance appears to exist so largely in the bark, as to form probably an impervious coating.

Of the different kinds of stone used as building materials, has any particular kind been exempt from injury? Have the more purely siliceous stones been less injured than the carboniferous or the aluminous? I regret, however, that for the want of more complete data, I can not make satisfactory inductions, but think that carbonate of lime, either as mortar or a constituent of the stones, has been a principal cause of injury. It is well known that this substance is decomposed at a comparatively low temperature, as in lime-burning, while the more simple composition of siliceous substances would undergo little change at even a high temperature.

Mr. Faraday concludes that all substances are conductors of electricity, more or less, and from the quantity of iron in many building-stones, they are often tolerably good conductors. All exposed points of high buildings will thus be more or less traversed by this fluid, and consequently liable to injury.

I am, Sir, yours, &c.,
W. G.

[Our correspondent deserves great credit for bringing forward in this way a subject of such importance to the Architect as that of preserving buildings from injury by lightning. Every day's experience appears to confirm the accuracy of his opinion, that the shock produced by lightning when it strikes an object is of an explosive character, since we find in many instances that stones have been shattered into small atoms and thrown several hundred feet from their position in the building. Should the theory he has advanced ultimately gain ground, we may look to other and more substantial means of security than those which are furnished by the lightning conductor, a contrivance which, however judiciously constructed, can never be depended on with certainty, as many recent instances too clearly bear witness. We shall be glad if those of our correspondents who possess opportunities of the kind, would favour us with any facts which have come under their observation relative to the precise force and nature of the damage sustained in cases where buildings have been struck by lightning. It is by an accumulation of such facts that the theory here suggested will be either confirmed or overturned, and in any case they will serve to throw light upon a subject which deserves the Architect's best consideration.—Ed.]

ON THE LEAD COUNTRY OF NORTHUMBERLAND, DURHAM, AND CUMBERLAND.

DR. MITCHELL'S REPORT. *(Continued from page 246.)*

Where the matrix of the ore is usually soft and easily broken, a stamping mill may be dispensed with; but for very hard ore it is exceedingly useful. Some washing establishments have not got a stamping mill. After the ore has come from the chat-mill, and the smaller portion has been carried off by water, it is taken up and put into a sieve, to undergo the process technically called hutching. The sieve is made of iron wire, and it is let into a box which is full of water. From the stalks or chains of the sieve proceeds a long lever, which rests upon a fulcrum, and at the end of the lever stands a boy, who places his two hands above his head, and pulls the end of the lever down to him, and lets it up again a few inches, and in consequence, the sieve with the ore upon it is raised up and down with agitated motion in the water in the box. The boy keeps on doing this for some time. The effect of this motion on the sieve is, that much of the very small lead or dust falls through the sieve and sinks to the bottom of the box, and is called smiddum; and then, of that portion which remains above the sieve, the lead, being the heaviest part, works down to the lowest place next the wires of the sieve. Immediately above the lead are the larger pieces of stone with portions of ore, which are called chats; and above the chats are lighter bits of stone called cuttings. The cuttings are removed off by a limp, which is a broad piece of iron, and is given to the cutting cleaners, and is again put into a sieve and treated as before, and the chats are sent back to the chat-mill to be again ground.

It has already been stated, that when the ore was laid on the grating, the smaller portions were carried through the bars to a pit below by the stream of water. Part of this matter carried into the pit below is sludge or slime, which is carried further down the stream to pits, in which it settles; but there is another portion much too large and weighty to be thus carried off. This portion is taken up out of the pits, and is put on the sieves, and is hutched; that is, it is jerked or tossed up and down on the sieve in the water, by the boy pulling at the end of the lever; and when sufficiently well hutched, the stony matter is carried off by the limp, and the clean ore lying at the bottom is taken to the bingstead.

It will appear a necessary consequence to every one who has paid attention to the description of the preceding operations, the grating and crushing of the ore under the action of water, that a great quantity of finely pulverized earthy matter must have been produced, and much lead in the form of minute detached particles must have been brought away in company with the pulverized matter, and carried down the stream with the water. Now there are pits one after the other into which the water is made to flow, and in which the water deposits all this matter, which is merely mechanically diffused through it. This composes a mass more or less stiff, and that portion of it which is coarse and contains large grains of lead, has been called sludge, and the matter consisting of smaller and finer particles, has been called slime.

OF ROASTING THE ORE.

The lead-ore is roasted in a reverberatory furnace. It is precisely on the same principle as the reverberatory furnaces used for puddling iron, and the balling furnace used for heating the iron before passing through the rolls. A bing of lead ore is introduced at one time, and the heat applied. The ore is heated to ignition, but not to melting, that is, the ore is made to approach in heat as near to melting as possible, but still is not melted. Too little heat or too much would be equally bad. The flame of the fire strikes against the ore, and it soon shows a yellow flame. The ore is stirred with what is called a paddle, which is an iron rod with a broad piece of iron at the end. The stirring must be repeated five, six, or seven times in a heat. The time of a heat depends much on the nature of the ore, and may be one hour and a-half, two hours, two hours and a-half, or three hours. About two hours and a-half is the medium. Meanwhile, a barrow containing a bing of ore is wheeled from the bingstead, and is placed right over the furnace, to be ready to be let in when it is wanted. When the ore is sufficiently roasted, it is raked forward by little and little, and let fall into a cistern of water. This takes place with great noise, and the heated water flies up, but is prevented reaching the workmen by a plate of iron which intervenes. The roasting furnace is of the kind called a reverberatory furnace; that is, one in which the flame and heat are carried forward by the draught of air, and dashed against the bodies that are to be heated or smelted. The puddling furnaces and balling furnace used in making iron, are on the same general principle. When one heat is done, another bing is let into the furnace, and the same work goes on again. Two men are engaged at a time, and they work eight hours; when two other men come on and work eight hours, and so they go on working eight hours and resting eight hours, day and night for four days in the week. They then go home and have three days cessation from their labours. It is a great saving of fuel not to let the furnace cool. The masters also say that it is a high benefit to the men to work hard, and then get away for a considerable time, to bring themselves all fresh again.

The effect of roasting the ore is to drive off the sulphur from the galena, or sulphuret of lead, of which the ore is composed: also antimony, and other matter more volatile than the lead; also the small dust ore is made to adhere together, whereas, if it were to be put into the smelting hearth and exposed to the blast, a great portion would be blown away. It is however the case, that at places far from coals, and where in consequence fuel is very expensive, there is much ore which does not undergo the process of roasting, but is put at once into the hearth. The roasted ore is let fall into water to prevent its forming into too large unwieldy lumps, if it were to be thrown down and left to cool in a heap. The ore is taken from the water and carried to the smelting-house.

OF THE SMELTING HEARTH.

The usual size of the smelting-hearth is about twenty-two inches long and twenty-two broad, and about the same in depth; but the dimensions vary exceedingly at different places. It is made of cast iron. It is usual to charge it with the half-melted matter of former operations, and then with peat and coal, and the roasted ore. A large bellows is made to throw its blast into the hearth; two men working together stir the melted lead, and gradually add more ore. There is a small channel from the hearth in which the melted lead may flow down into a pot at the side of the brick work in which the hearth is fixed, and from time to time the melted lead is let run down, and from this pot the men lift up large ladles of the metal, and pour it into moulds of eight stones each, or sometimes twelve stones each. At most smelting mills, the smelters are divided into three sets, of two men each, and they come in turns, ten hours each set at a time, so that a man works ten hours and rests twenty hours, and the smelting goes on from early on Monday morning to Saturday afternoon.

Lime is sprinkled on the edge of the hearth, when the melted slag is running off, which has the effect of uniting with the slag, and converting it into a solid form.

OF THE SMELTING FURNACE.

The smelting furnace is of the same description with the roasting furnace, as already described, and the roasting and smelting are both done in one heat, which, however, occupies about five hours. Coal is mixed up with the ore, in order to make it smelt. A bing of ore is roasted and smelted at one shift. The smelting furnace takes more fuel than the smelting hearth, and it is not used when the place is at a distance from coals. The process of roasting goes on first; and when that operation is effected, the doors of the furnace are shut, and the heat is increased so as to smelt the ore.

OF THE HORIZONTAL CHIMNEY.

The most important circumstance connected with the smelting mills, is the chimney by which the smoke and effluvia are carried off. About twenty years ago, they had begun to make what are called horizontal chimneys, about 100 yards in length, but they are much longer now. In going across from Stanhope to the Derwent Company's mines and smelting mills, on the river Derwent, I saw at the top of a hill a tall white circular turret, rising up out of the ground, and a cloud of white smoke issuing from the summit. The road came to within the distance of a quarter of a mile from it, and the smoke, as we passed through it, was disagreeable. The ling, or common heath, had its blossoms and leaves entirely destroyed. The bell heather (Erica cinerea) was more hardy. This chimney was a mile from the smelting mills, and it was stated by the people that it proceeded underground, all the way from the mills, up the side of the hill, to the foot of this turret, to carry off the destructive smoke. It was also said (and the same statement was made at many other places afterwards), that if the smoke from the smelting mills should fall on the ground around the mills, the grass would become so poisonous, that horses or cows partaking of it would die, chiefly from constipation of the bowels. Mr. John Robinson, the agent of the Derwent Lead Company, gave the following evidence on this subject:—

"To save the surface of the land from injury, we carry from the smelting hearths a tunnel, arched, a mile long, and let the smoke up the chimney. At the end of the year we clean the chimney, and smelt the matter obtained, called fume, and get from this a great quantity of lead, sufficient to remunerate for the expense of making the tunnel, and yield a profit besides. Mr. Beaumont is now making a chimney in Allendale, three miles long. It is known that he must make many thousands a year by his chimneys. We think of lengthening our chimney. The farthest smoke we find is the richest in lead, and we expect that, by lengthening our chimney, we shall derive more advantage. The tunnel, or chimney, is made three feet wide, and six feet high, so that a man can walk along it to clean it, and bring out the deposits." Subsequently to receiving Mr. Robinson's evidence, I had an opportunity of seeing the chimneys of Mr. Beaumont's smelting mills. There is also a long chimney of the Langley smelting mills, within a few miles of Haydon Bridge. The effluvia from the roasting furnace is not reckoned so injurious as that from the smelting hearth, or furnace, and sometimes it is not introduced into the long chimney, sometimes it is. The smelting mills are, of course, in a low situation, on account of the water to turn the wheels, which give motion to the blasts. It is obvious that a tunnel carried from such a situation up the side of a hill, to a great height, will have a great draft of air, and consequently will draw off the smoke and effluvia from the metal, and consequently the noxious matter, which is found to be ruinous to the health of the men, will be carried away, and the mills will be rendered much more healthy. We should expect, therefore, that at all the smelting mills there were such chimneys, more especially as they are found to have so much lead deposited in them, as to pay the expense of erecting them, and after that to yield a large profit. But improvement is slow; many have not adopted the use of these chimneys, and others have done so only to a limited extent. Even in the case of the London Lead Company, the smelting mills at their Neuthead station are near the public road; and when the wind carries the smoke upon the road, as, from the prevalence of south-westerly winds in this country, must be the case three parts of the year out of four, it is most offensive to travellers, and in a populous district it would not be endured for half an hour. Even at the distance of half a mile it was disagreeable, and would be destructive to the health of a person who remained long in it. When the wind blows in such a direction as to carry the smoke to the washing-floors, upon the children, or upon the village, it must be disagreeable. Smelting mills in a hollow amongst the hills, where there is little or no current of air, must in consequence be exceedingly unwholesome. The Greenside smelting mills, in Glenridding, a dale running up from the west end of Ulleswater, were spoken of by many of the miners and smelters as the most unwholesome of all, and I went to see them. When at some distance I met some of the men, who confirmed the previous bad accounts; but they added the very agreeable information, that preparations were going on for carrying the

chimney up the side of the steep hill, which would remove the smoke far above the mill, and out of the way of mischief. The manager, Mr. Little, confirmed this account; and I saw myself the men at work, making the deep trench in the hill, in which the chimney was to be built. The proprietors would then be able to have their washing-floor near their mills, which at present was quite out of their power. All the men who were examined have stated their decided opinion, formed on their own experience, that the smelting mills were sufficiently healthy, if well ventilated. No excuse can be tolerated where such is not the case, more particularly as it has been found that the means for producing ventilation, instead of being a loss, are a source of great profit to the proprietors.

OF REFINING THE LEAD AND SILVER.

The process of refining the lead and silver depends on this principle—that lead exposed to heat readily imbibes oxygen from the atmosphere, and becomes oxide of lead, whilst the silver remains unaltered. The process is carried on in a reverberatory furnace. The flames from the fuel strike against the lead and silver, and the lead is converted into litharge. The silver forms a plate which remains below. Before the metal is put into the reverberatory furnace, a test is made from bone ashes and the ashes of burnt ferns, or braken (Pteris aquilina). This plant, when burnt, yields a good deal of vegetable alkali, or potass, in its ashes, and to this quality it owes its value as a test. A mixture is made of the bone ashes and of the fern ashes, and the whole is beat up with water, and a figure is made into an oval form, which is placed within an iron frame, and then the iron frame is placed in the furnace, and the pig of lead is placed over it. The use of the test is, that it absorbs some of the litharge which comes in contact with it below the silver. The furnace acts, and the flames change the lead into a semi-vitrified oxide of lead, or litharge, the melted lead abstracting oxygen from the air. There is an opening at one side, and from the other side comes the blast of a large bellows, which blows the litharge from off the surface to that side, and also makes it fall over through the opening, into an iron vessel placed to receive it. This vessel is removed when nearly full, and another vessel put in its place. The test absorbs such litharge as is below the silver, and part of the silver. It may last three days. When it is fully saturated it must be removed, and another test is put into its place.

OF THE SEPARATION OF LEAD AND SILVER.

The new mode of separating the lead and silver, is a discovery made about ten years ago, by Mr. Hugh Lee Pattinson, of Alston. He was an agent of the Greenwich Hospital, and it was his duty to test the lead paid to them as their royalty, to ascertain the quantity of silver which it contained, and to determine its value. He observed in the course of conducting his operations, that part of the lead crystalized before the rest, and was led to attempt to discover the cause, and on analysis, he found that the portion which remained longest liquid, contained a larger proportion of silver. The principle once discovered, the application of it was not difficult to effect. The benefit of the new process was so obvious, that it was speedily adopted by the lead proprietors, and the inventor has liberally profited by his discovery.

Of this operation I shall endeavour to give a description, as I first saw it performed at the Balyhope smelting mills in Weardale. There were three large pots of cast iron built into brick along the middle of the room. We may call the pots No. 1, No. 2, and No. 3. Near No. 1, there was a small pot, and there was another small pot near No. 3. The lead is melted in pot No. 1, and a man stands on one side with an iron rod and stirs the metal, and every now and then he strikes off the lead which adheres to his rod with a great hammer. On the other side is a man with an iron rod, at the end of which is a great ladle full of holes. He dips it into the pot of melted lead No. 1, and pressing the rod on the edge of the pot as a fulcrum, he raises up his ladle, which appears nearly full of lead, curled, crisping, and frosted, and from the holes in his ladle runs out clear liquid metal. The workman holds his ladle above the surface, and shakes it until no more liquid metal will run out; and then he empties out the lead in his ladle into pot No. 2. He dips his ladle into the little pot, which has lead in it, and is kept very hot, and thereby melts the lead which had adhered to his ladle. He keeps on repeating this operation, until there be very little liquid metal left in pot No. 1. If there be a breeze of wind through the room the lead cools faster, and the work goes on more rapidly. The metal left in pot No. 1, is brought into moulds, and cast into pigs. The lead which was put into No. 2, is melted, and is treated in exactly the same way as the lead in pot No. 1, as now described. The lead taken away is put into pot No. 3. The lead in pot No. 3 is melted, and treated in the very same way again. The lead will now contain so little silver, that it would not defray the expense to melt it a fourth time. But there are mines where the lead is much richer, and at Greenside mine, there are five pots in the separating room, and the lead is separated five times. In the lead of this mine there are, however, from twelve to fourteen ounces of silver to the ton of lead, and there will be sufficient silver in the lead, after it has been melted and separated the third and fourth time, to cover the expense, and yield a profit in melting it a fifth time. It was stated to me, that at Newcastle, where coals were cheap, the lead of some mines was melted and separated as many as seven times. A much greater quantity of silver is extracted in this way than by the former method. Under the old plan, where the silver could not be obtained, but by converting all the lead into litharge, and they had to reduce the litharge back into lead again, a great deal of lead was lost; now it is necessary merely to convert into litharge those pigs in which the silver remains. Four tons of pig lead, as it comes from the smelting-hearth, will by separation, leave only 12 cwt., which will require to be made into litharge, instead of the whole quantity, as under the former system. The lead which is separated in the way explained, is merely melted, and cast into pigs of eight stone or twelve stone, as may be thought fit. At Greenside Mine, 757 tons of lead were made in 1840; and under the old system, the manager said that only 700 tons could have been obtained. At some smelting mills, there are several sets of pots, but one set resembles another.

OF THE REDUCING FURNACE.

Under the new system of separating as much as possible of the lead, before the remaining lead and silver is subjected to refining, comparatively little litharge is now made. More, however, is made than can be sold at a remunerating price, either to the glass-makers, or to the colour-makers, and therefore much litharge is reduced back to the form of the regulus of the metal: this is done in a reverberatory furnace. A layer of coals is laid at the bottom of the furnace, and the litharge is mixed with small coal, and the mixture is put into the furnace, and is exposed to the flames. During the combustion, the small coal abstracts the oxygen from the litharge, and the pure lead is the result. It is cast into pigs of twelve stone each, and is in a marketable state.

OF REDUCING THE SLAG.

The slag is put into a furnace and mixed with coke, and it is heated by fuel beneath. The oxygen of the slag enters into combination with the fuel, and the lead is separated, and it runs out from beneath, and is cast into pigs. This lead is less valuable than other lead, and the pigs are very easily broken.

REVIEW OF BOOKS.

The Alhambra—Plans, Sections, Elevations, and Details, from Drawings taken on the spot. By the late M. Jules Goury, and Owen Jones, Architects. London: Published by Owen Jones, 1842.

The dominion of the Moors in Spain, extending over seven hundred years from the first conquests effected by the Arabian tribes to the expulsion of their descendants from Granada, at the close of the fifteenth century, has left behind it indelible traces of a wise and mighty people. Fired with religious ardour, impelled by the most enthusiastic zeal for the cause of their prophet, the Arabs who first entered Spain, speedily overran the whole country. They even crossed the Spanish frontier, and repeatedly pillaged the neighbouring provinces of France, till at length they were met by Charles Martel, the grandfather of Charlemagne, and suffering a signal defeat on the plains of Aquitaine, the crescent was for ever expelled from France, and its champions never again attempted to pass the Pyrenees. This check to their military conquests, however, only diverted into other channels those energies which had led the wild and daring followers of the Prophet to exchange the solitude of their scorching deserts for the inspiring climate and fertile soil of Spain. The passion for military glory now gave place to the pursuit of all that was elegant and alluring in literature, renowned in science, and useful in the arts. Not only does the language of Spain at this day abound with traces of the Moorish dialect, but even the names of many of the sciences, as algebra and alchemy, will for ever attest among the nations of Europe the origin from which they sprung, and point to the era of Arabian learning as the nurse of some of the loftiest pursuits to which the human intellect has ever been devoted. The gigantic aqueducts, and extensive canals and roads, the splendid mosques and luxurious baths, of which the remains are scattered over Spain at this day, afford some idea of the wealth, the wisdom, the internal and colonial resources of this great people.

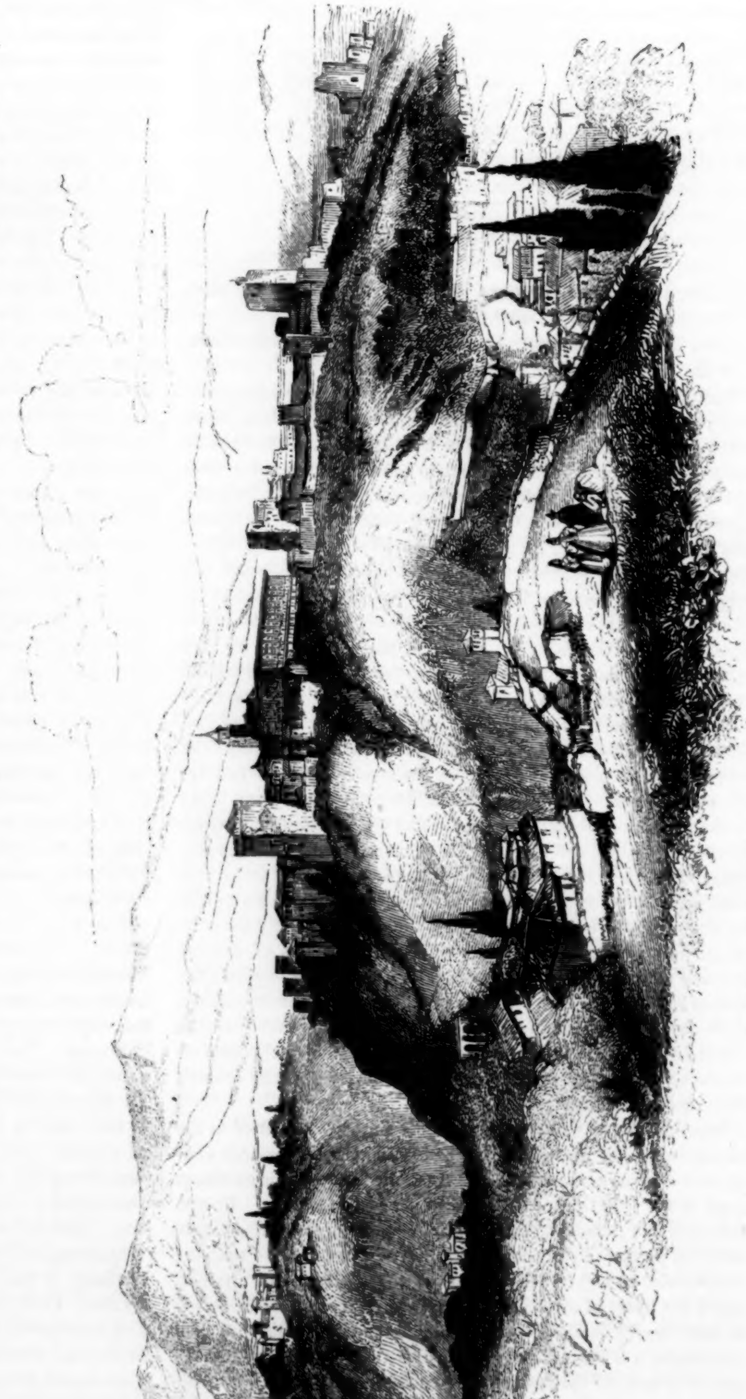
It is remarkable that whilst Christian Europe was buried in the lowest depths of ignorance and barbarism, the Mahomedan conquerors of Spain concentrated in that remote corner of the continent most of the learning and the arts of Greece and Rome. Poetry, theology, and grammar, were favourite studies; the mathematical sciences, particularly in the departments of geometry and analysis, were carried to higher perfection than the ancients had attained, and if the lustre of their discoveries in chemistry and medicine was in some degree obscured by the wild and fanciful dreams of their alchemists, it is due at least to remember that alchemy itself is the parent of some of the most useful combinations which modern chemistry can boast of. Numerous arts which were practised by this people are now lost to the world, particularly those of mural and other kinds of decoration. The more important remains of their scientific and mechanical achievements which have been handed down to us, comprise the invention and introduction of writing paper into Europe, the improvement and first use of gunpowder for military purposes, and a discovery of no less consequence than that of the mariner's compass has been usually ascribed to them. Agriculture in all its branches, comprising a highly scientific and practical acquaintance with botany, was carried to great perfection. The numerous canals and mills for raising water for purposes of irrigation, some of which are still scattered over the plains of Andalusia, Valencia, and Granada, attest the scientific skill and elaborate pains with which the fertile vegas of these provinces were treated, their golden harvests of rich grain and delicious fruits amply rewarding the labours of their grateful and industrious possessors.

During the first seventy years after their possession of Spain, the Mahomedans appear to have been governed by viceroys appointed by the sultans of Africa. An independent monarchy then arose, which, during the period of its sway, extending over two hundred and fifty years, and terminating about the year 1031, was remarkable for the many brilliant discoveries and successful achievements which it witnessed in the arts and sciences. The Mahomedan empire of Spain was by this time, however, greatly contracted in extent. Vast armies from the north had disputed with the Mahomedans many of the northern and central provinces, which, after being again and again conquered and re-conquered alternately by the Christian and the Moslem armies, appear at the termination of this period to have become firmly fixed in the possession of the former. The dynasty of this period (756 to 1031) composed the kaliphate of the west, and is celebrated by the Arabian historians as the noble race of Beni Umeyyah. The monarchs of this race adopted the title of sultans of Cordova, which city they beautified with many splendid palaces, mosques, and baths, and intersected the neighbouring provinces with numerous lines of road and canals for supplying water to their cities, and for irrigation. They supported an immense military force to maintain possession of their kingdom, while, to defend their coasts from foreign invasion, a royal navy of unequalled extent in those days swept the shores of the Mediterranean, ensuring safety to their homes, and security to their commerce.

A period of civil warfare now succeeded. The next two centuries (1031 to 1250) witnessed many furious rebellions, during which the Christians early possessed themselves of the greater part of New Castile, while, towards the close of the period (1236) Cordova itself, the stately capital of the Mahomedan empire, yielded to the Christian arms. They also became possessed of Denia, Valencia, and of all the fortresses on both sides of the Guadalquiver, from Jaen to the gates of Seville. This period was distinguished by the incursions of two powerful tribes of African Moors, the Almoravides, and the Almohades, who, rushing from the deserts around Mount Atlas, successively fell upon Spain, and established two short-lived dynasties, the termination of which saw Seville herself a Christian city. And now the kingdom of Granada attracts the most prominent notice in Moorish history, their dominion being now almost confined to this province, whose sovereign (Mohammed Ibnu l-ahmar) about this time became a vassal of Ferdinand III. Here also commences the history of the Alhambra, concerning which it is disputed whether this sovereign or his successor, Mohammed II., commenced the erection of the magnificent pile. The great mountain fortress of the Alhambra had long existed, since we hear of the towers of the red castle (Kal 'at Al 'hamra) even in the eighth century; but the palace built within the walls of this fortress claims no higher antiquity than that of about the year 1270. The situation of this magnificent palace is one of the finest that can be conceived.

It stands on the side of a lofty chain of mountains, called the Sierra Nevada, encircling one of the richest and most fertile vales which ever contrasted with the boldness and sterility of a mountain district. The towering summits of the Sierra Nevada, covered with perpetual snow, rise far above the splendid halls of the Alhambra, while on each side of the once regal palace a series of bristling forts, appearing as solid and as enduring as the rocks from which they rise, give to the whole mass of mountain, palace, and forts, the unity of some gigantic castellated structure, surpassing in its magnitude all that could be conceived practicable by human resources. In the valley at the base of the mountain glides the crystal Darro, which, shortly uniting its waters with the Zenil, flows in a north-westerly direction, and falls into the Guadalquiver, below Cordova. On the side of the Darro lies the city of Granada, forming nearly the north-eastern extremity of the valley or Vega, which stretches far away to the north and north-west. When we add to the magnitude and impressiveness of the enormous piles which compose the Alhambra and its surrounding forts, rising as it were out of, and forming parts of, a great whole, into the composition of which enter the gigantic features of the Sierra Nevada itself; when we picture in addition to this the beautiful city of Granada, lying before it in the sunny repose of conscious security, guarded by the towering bulwarks of the mighty fortress, which looks down upon it; when we conceive the exquisite fertility and beauty of the vale of the Darro, rich in all the productions of the most favoured soil and climate, refreshed by innumerable rills which have been industriously conducted over its surface, and stretching far away, and spreading out into a rich and gorgeous carpet, gemmed over by clusters of white farm-houses, and studded with beautiful villas, breathing into the landscape of nature a delightful animation, without disturbing its harmony, we shall have before us a vision which might well incite the charms and eloquence of Arabian song, and for which the descendants of the Prophet might well sigh, long after their ancestors had been driven from their Spanish homes.

Besides the lighter and more artistical sketches of Lewis, those of Roberts, which have been engraved for the Landscape Annual, have made familiar to the British public some idea of the beautiful architecture and decoration of the Alhambra Palace. The more elaborate German work of Hessemer* has higher claims in a professional point of view, the details being drawn on a large scale, and being coloured in imitation of the original. The great



GENERAL VIEW OF THE ALHAMBRA FORTRESS, AS IT NOW APPEARS.

* Arabische Bauverzierungen.

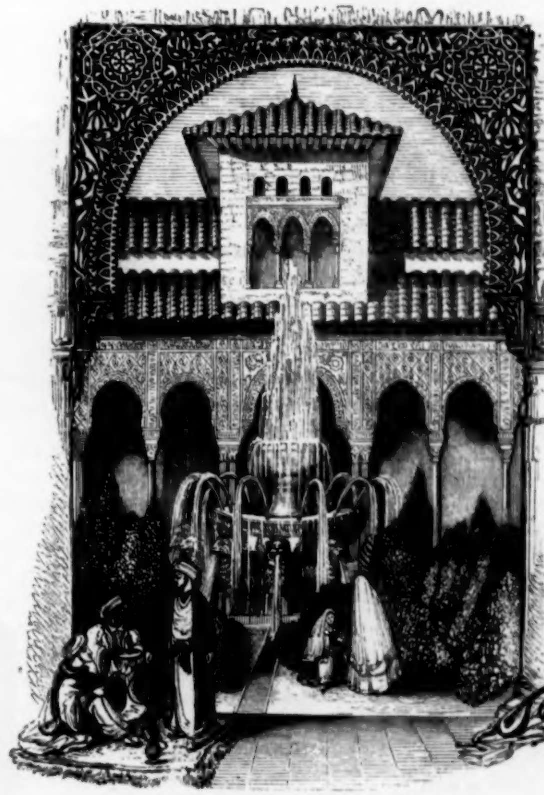
work, however, commenced in 1834 by Mr. Owen Jones, in conjunction with M. Jules Goury, a French architect, and of which the first volume is now before us, surpasses all others which have hitherto attempted to do justice to this splendid relic of Moorish greatness. Six months after the commencement of their labours Mr. Jones had the misfortune to lose his friend and coadjutor M. Goury, who died of cholera during his residence in the Alhambra. Since that time Mr. Jones again visited the Alhambra in 1837, and an idea of the immense labour which he has bestowed on this work may be gathered from his assurance, "that an impression of every ornament throughout the palace was taken, either in plaster or with unsized paper, the low relief of the ornaments of the Alambra rendering them peculiarly susceptible of this process."

The exterior architecture of this celebrated palace, like most other buildings of Moorish origin, is distinguished by an air of rude and massive grandeur, which affords no index to the lavish splendour of ornament and decoration which prevails in the interior. This contrast serves greatly to heighten the effect on the stranger who enters their spacious courts and lofty halls, whose floors are paved with the richest marbles and most brilliant mosaics, the gilding of their painted walls and marble columns blended with the brightest colours of azure and vermillion, the whole arranged with the most tasteful and artistical regard to effect on the eye, in order that the beauties of the mosaics may not be diminished by the greater brilliancy of the primitive colours, in which the capitals and distant parts of the walls are painted. The Alhambra presents some splendid specimens of the horse-shoe form of arch, in which the length of the curved line is considerably greater than a semicircle, presenting thus the nearest approach that can be given to the shape of a crescent; which favourite symbol of the Mahomedan faith also prevails extensively in all the ornamental carving both of the wood and stone work.

The ruins of the Alhambra which at present exist, are not supposed by any means to correspond with the original extent of the structure. The palace of the Emperor Charles V., a huge square pile of masonry with a circular court in the centre, undoubtedly occupies a considerable part of the site of the Moorish palace, which must have been there removed to make way for the more modern structure. M. Pascal observes on this subject, "From the comparison of this edifice with other residences of eastern potentates, such as the seraglios of Constantinople or Adrianople, we feel convinced that very much is wanting to render this building as perfect in size and grandeur, as that portion which remains is in detail: we find no traces of the numerous apartments which must have been required by the guards and attendants; and a most important feature, the Harem, is entirely wanting."

The remains of the palace consist of an irregular pile of buildings surrounding two spacious courts, the one called the Court of the Fishpond, the other the Court of the Lions. The principal apartments around these are the Hall of the two Sisters, the Hall of the Abencerrages, and the Hall of the Bark, so called from its resemblance to the form of a boat. At the rear of the palace rises the lofty Tower of Comares, in which is situate the Hall of the Ambassadors, and in addition to this there are upwards of twenty detached towers, principally in the line of the wall which surrounds the whole fortress. These towers are all built of concrete, and present a very rude exterior, but some of those in the vicinity of the palace contain small and beautifully decorated apartments, which seem to have been devoted to the use of the favourite sultanas.

The engraving below represents on a diminutive scale the entrance to the Court of the Lions, which is thus described in the letter-press referring to the plate.



COURT OF THE LIONS.

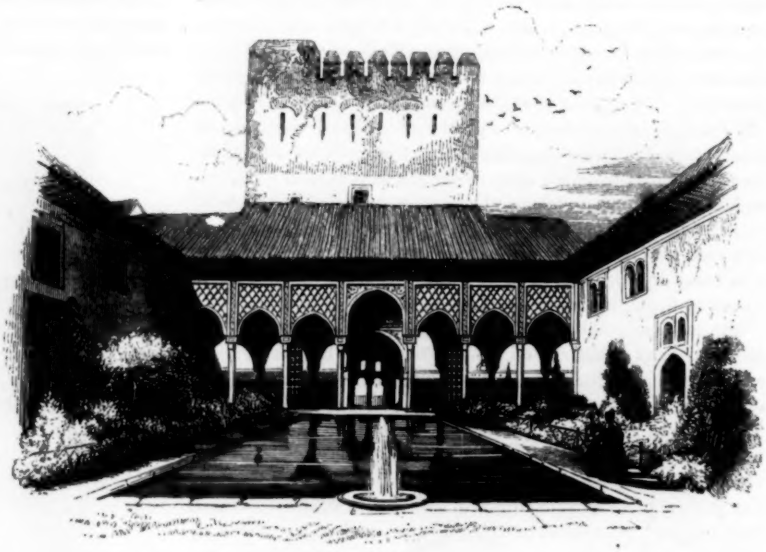
"The Court of the Lions (so called from the fountain in the centre, supported by these animals,) appears to have been the most perfect portion of this royal palace. It is a parallelogram of one hundred feet by fifty, and is surrounded by a portico, with small pavilions at each end. The portico and pavilions consist of one hundred and twenty-eight columns, supporting arches of the most delicate and elaborate finish, still retaining much of their original beauty: the various colours, however, of the ornaments are wanting. During the repeated restorations which the palace has from time to time undergone, the walls of this Court were defaced by several coats of whitewash, beneath which it is still possible to discover traces of the original colouring."

The small engraving above conveys a very faint idea of the magnificent plate which exhibits the detail of the arches in the Court of Lions. All these plates present exquisite studies for the architect, but it is impossible without seeing them to form an idea of the beauty of their execution, and their value in a professional sense.

"The Court of the Fish Pond" is so called from a large basin, or fishpond, which it contains. The court is paved with white marble, and the pond, which is 120 feet in length by 30 in breadth, was surrounded by hedges of roses, and filled with the most beautiful gold and silver fish. The engraving below represents the

Court of the Fish Pond, looking from the Hall of the Bark, which separates the Court of the Fish Pond from the Hall of the Ambassadors.

"The entrances to the ancient fortress of the Alhambra appear to have been four: the Torre de las Armas (Tower of Arms), in the Alcazaba; Torre de los Reges Catolicos (Tower of the Catholic Kings); the Torre de los Seite Suelos (Tower of Seven Stories); and the Puerta de Justicia, or Gate of Justice. The latter was formerly, as it is now, the principal entrance into the fortress. Like all the other towers of the Alhambra, it is built of concrete, the jambs of the doorway being, however, in white marble, and the elegant horseshoe arch and spandrils, of brick."



COURT OF THE FISH POND.

We regret that our limits will not enable us to do anything like justice to the style and arrangement of Mr. Jones's elaborate publication. Such a work deserves the encouragement not only of every architect, but of every man of taste throughout Europe, and we do hope sincerely, that the scanty collection of subscribers, whose names have been published, will be multiplied a hundred-fold as soon as the work comes to be known and appreciated as it deserves.

GATE OF JUSTICE.

We have heard—but we do trust, for the honour of both France and England, that the report is without foundation—that the high-minded and public-spirited individual who has devoted so many years of his life to the cultivation of the Moorish architecture, and to the object of making the world and the profession acquainted with this—its most magnificent example—is likely to sustain a very serious loss by the publication of this great work. If this be true, it will indeed be a national disgrace, and more particularly a disgrace to the profession in whose cause such spirited exertions have been made. The letter-press accompanying the plates is from the pen of Mr. Pascal de Gayangos.

We cannot do better than conclude this notice with the following

brief, yet beautiful extract, referring to the general origin of the Moorish style of architecture.

"The severe but picturesque exterior of the towers gives no indication of the art and luxury within: they were formed without like the palaces of the ancient Egyptians, to impress the beholder with respect for the power and majesty of the king; whilst within the fragrant flowers and running streams, the porcelain mosaics and gilded stucco work, were constantly made to remind the owner, how all that ministered to his happiness was the work of God. The architecture of the Arabs is essentially religious—the offspring of the Koran, as Gothic architecture of the Bible. The prohibition to represent animal life caused them to seek for other means of decoration—inscriptions from the Koran, interwoven with geometrical ornaments and flowers, not drawn decidedly from nature, but translated through the loom; for it would seem that the Arabs in exchanging their wandering for a settled life—in striking the tent to plant it in a form more solid, had transferred the luxurious shawls of Cashmere, which had adorned their former dwellings, to their new—changing the tent-pole for a marble column, and the silken tissue for gilded plaster."

ENGINEERING EMPLOYMENTS.

There are certain works of engineering which are constantly required in every part of a civilized country, and the management of which is distributed amongst a variety of local officers, not possessing as a body the qualifications, nor pretending to the title of engineers, and yet controlling in the aggregate the expenditure of considerable sums of money in engineering works, and superintending the execution of many important constructive designs. Amongst works of this class may be comprised the supply of water and of gas to cities and towns, the drainage and sewerage of towns, the construction and repair of streets, pavements, and highways, and the regulation and survey of buildings in conformity with the provisions of building acts. Now the salaries paid annually to the several officers appointed to manage these affairs, although separately quite paltry and insignificant, and by no means sufficient to remunerate an educated and talented man, are yet, when added together for any given district, of ample amount to secure the services of one competent person, who would be able to superintend the whole of that in which five or six persons called surveyors are now engaged. This is a consideration of some importance at a time when the notion is becoming prevalent that engineers have been lately multiplying with such rapidity as to exceed the demand which can ever arise for their services. The fact is, on the contrary, that engineers are not half numerous enough, and this is the reason why such gross blunders are constantly perpetrated in the appointment of local officers to manage what may be termed a minor kind of engineering business. There are few persons in any part of the country unacquainted with the shameful incompetence of the road surveyors appointed in all country places, or with the infamous abuses to which the appointment of such men gives rise. It is well known that a grocer, a baker, a butcher, or any other kind of man who keeps a shop, is considered by the local authorities just as eligible for the office of road surveyor as any to be found, and accordingly the appointment is commonly given by the parish to some shopkeeper, who is endowed with more impudence, more laziness in attending to his own vocation, and a more restless disposition to engage in what he does not understand, and in what he has no business with, than the rest of his fraternity.

In purely rural districts again, the road surveyor is commonly a farmer, who, although superior to the shopkeeper in the kind of knowledge he possesses, and who at least knows the difference between one kind of stone and another, and who frequently has some vague notion that a road requires a system of drainage, is yet often the worse public servant of the two. This happens because the farmer cannot act in his office with impartiality. The ruling passion of selfishness is in his case too severely contrasted with the unprejudiced line of duty which he ought to follow; as, for instance, we can scarcely conceive him to be unbiassed in favour of the particular road which passes by his own farm, on which his own waggons travel, and the heavy draught on which is so injurious to his own cattle. The roads then in which the surveyor's own interest is concerned may naturally be expected first to claim his attention, and as the funds applicable to the roads are always limited, an undue outlay in any one part of the parish, is synonymous with a corresponding neglect of other parts. The roads therefore which have been neglected during the administration of farmer A. must wait their turn till farmer B. comes into office, when of course he retaliates upon those which had been favoured by his predecessor, and devotes all the money and labour at his command to improve those which Mr. A. did not think it expedient to trouble himself about.

This kind of management is of course as bad as it well can be, and its evils can only be exceeded by the rivalry which we have sometimes observed between shopkeeper surveyors, where one perhaps professes to be a follower of Telford and the other embraces the doctrine of Mac Adam, each waiting his turn to prove to the world the superiority of the favourite system, of which he has gained an unlucky knowledge from some manual or other. We say unlucky, because it is impossible for men entirely unacquainted with the subject, and whose pursuits all through their lives have been widely at variance with those which would qualify them for road surveyors, to acquire from a few brief instructions intended for professional surveyors, or at least for surveyors acting under efficient superintendence, a knowledge which will be of any use to them in the actual practice of road-making. A little knowledge is ever a dangerous thing, and here it is also an expensive thing, as many parishes have found to their cost when their surveyor has taken it into his head to apply the principles he had acquired from some book to the actual business of making or remodelling a road. The disciple of MacAdam is not unfrequently heard to boast of the triumph with which he destroyed the works of his predecessor—the champion of Telford—and reconstructed the surface of the road without the under-pitching which the other had used, the unfortunate parish in the mean time groaning under the expensive contentions of their combative road-makers. Again, there are countless examples of corruption when surveyors are appointed from amongst the townspeople, as, for instance, the shopkeeper has a brother or some other relation who is a farmer, and on his account certain roads must be particularly attended to, whilst others, as before observed, must necessarily be neglected. Particular gravel pits or stone quarries are supported by particular interests, which are favoured according to the faction which happens to be in power; and, in fact, the circumstances which induce a corrupt and inefficient management are too numerous to be particularized, while they

cannot fail to be in some degree obvious to every one who has ever taken the trouble to observe the working of the present system.

In large towns, although the appointment of surveyors to superintend the sewerage and the paving of the streets is certainly not confined to persons so inefficient as the road surveyors in the rural districts, yet the amount of knowledge even amongst these is commonly scanty enough, while the general complaint is, that they are greatly underpaid. Now, the remedy for all this is what Mr. Chadwick suggests, in his Report to the Poor-law Commissioners*, namely, to consolidate the whole of these local appointments in the person of one efficient officer, possessing the qualifications of a civil engineer, particularly the knowledge of construction, of the combination of building materials, and of the prices of every kind of artificer's work. A knowledge of levelling and surveying is also indispensable, both for the surveyors in towns and those under whose management the roads should be placed; and of course this knowledge would be comprised in the acquirements of any engineer undertaking such an appointment.

In this recommendation of Mr. Chadwick we concur most heartily, because, in the first place, it would confer great improvement on the aspect and the health of towns, and add to the comfort and convenience of our parish roads; and secondly, because it is just the kind of domestic employment required for the numerous body of young engineers at present qualifying in the several colleges which have lately been established for their education. We have no doubt that, in the course of a very few years, the recommendation of Mr. Chadwick will be carried into effect, even without the aid of legislative interference. The friends and connexions of the great mass of students who are now applying themselves to all the various branches of engineering, must constitute a very important and influential part of the community, and of course these will exert themselves to introduce the civil engineer to the united practice of those branches of his profession, which are now so much distributed, that the employment they afford scarcely confers any benefit whatever. Local boards and authorities also, in all parts of the country, when they see around them a number of talented and accomplished young men, whose education has been entirely directed to their qualification for the design and management of engineering works—when they see how advantageous it must be to avail themselves of the professional skill which young men so educated must possess,—will surely not hesitate to confer upon them the kind of appointments to which we have alluded. Considering the quiet, steady, and continuous kind of employment which these occupations would afford to the young engineer, extravagant salaries should not be expected. At the same time, nothing less than £200 a year can possibly be a remuneration for the exertions of a man who has gone through so wide a range of study, and applied the powers of his intellect so extensively, as an engineer necessarily must in acquiring a knowledge of his profession.

It should be observed, that the consolidation of the several employments of the official local surveyors, under the management of one individual, will not, as in many cases of the transfer of employment, be attended with injury to those who at present retain the separate offices, because their services are commonly so ill paid for, that they would be better without the appointments at all.

Mr. Chadwick points out, at considerable length, the evils of the present system of independent management; where, for instance, the surveyor of the sewers cannot act without obtaining the authority of the surveyor of pavements, to take up the road-way or paving of the street; and many similar cases might be adduced to show the complicated evils and absurdity of the separate appointments held by a number of surveyors, all acting for separate boards, and all independent of each other by office, while the works which they superintend require such a connected system of management, as can only be effected by concentrating the power over them in one board or in one person.

* General Report on the Sanitary Condition of the Labouring Population of Great Britain, 1842.

A NOTE ON LEVELLING.

We have received a communication from Mr. Bruff, on the subject of pressing upon the level legs, when the reading of the staff does not exactly coincide with any of the divisions. Mr. Bruff suggests, "that it might have been gathered from the minute directions given in many parts of the work (and particularly by the passage, 'when the back sight, &c.,' * that clearly intending that it was not to be used for a front sight), for setting the level for sight, that I could only have intended the slight pressure to be succeeded by a corresponding motion of the parallel plate-screws, to bring the bubble to the centre of its run before observing." Now this appears to us to be just the same thing as to say, *that between the interval of two observations, the bubble of the level is to be started from its true position in the centre of its run, by pressing on the legs, and is then to be restored to its place by turning the plate-screws.* What end, then, we would ask, is to be answered by this operation?—and would it not be much better, after setting the level, to make the two observations one after the other, without throwing the level out of adjustment, for the mere purpose, it now appears, of again setting it right by means of the parallel plate screws? Surely Mr. Bruff has not here explained himself with his accustomed clearness; for we really can scarcely believe that he means the passage quoted above to be taken literally. We have no desire to cavil upon the mere turn of a sentence, or the form of its words, but we cannot help observing here, that there appears in this explanation something quite at variance with the passage which the work itself contains, and which we quoted in our review last month. From that passage we really thought it was intended that the pressure was to be made, in order to produce an exact reading of the staff at some fixed division thereof. We then questioned the propriety of this, and we still question it; but now it seems this is not what Mr. Bruff meant at all, because the level is to be restored to its horizontality before observing. Hence, we again ask, why derange it at all?

Mr. Bruff goes on to observe, that "under many other circumstances the slight pressure may be resorted to without any impropriety, as in levelling over boggy ground, land much saturated with water, or during windy weather, in which cases the bubble will be pretty certain to move slightly from the centre of the tube, but might be restored, as I" (Mr. Bruff) "have mentioned;" and Mr. Gravatt is cited as an authority in support of this assertion. Now, even admitting for a moment, just for the sake of comparison, that the pressure would be justifiable in such cases as Mr. Bruff here mentions, there is still a wide difference between all this and that which we have just been commenting upon. In the case which is

* Mr. Bruff's Treatise on Levelling, reviewed in the Journal of last month.

now put forward, the bubble is started from its run by causes which the leveller has nothing to do with, and which he would be glad to get rid of, and he is therefore recommended to press on the legs to counteract the effect of these causes. But in the former case, he is deliberately told to start the bubble himself, and then to restore it, all for no reason in the world that we can discover. So much for a comparison of the two cases, and for the application of this example, even if it were confessed on all sides to represent a practice which may with propriety be followed in levelling. But we entirely dispute the propriety of this practice, and affirm, that when the level has been once set, any little irregularity occasioned by shaking of the ground, by wind, or by any other extraneous cause, should be counteracted by means of the screws, and not by pressing on the legs. We recommend that the legs should always be pressed *before* setting the level, in order that it may be made to stand firmly, and then that all further operations should be performed on the bubble through the medium of the plate screws *only*. Indeed, so delicate an instrument is the spirit level, so susceptible of alteration is the bubble by the slightest change in the position of the tube, that we doubt very much whether the softest imaginable touch that could be applied to one of the legs, would cause the bubble for one instant to retain any fixed position; and hence the impracticability of producing an adjustment by any pressure acting on the legs.

ON THE FORMATION OF BARS AT THE MOUTHS OF RIVERS.

BY W. A. BROOKS, ESQ., CIVIL ENGINEER.

SIR,

I HAVE read your pages in this month's Journal, professing to give reviews of several works, among which my own, "On the Improvement of Rivers," comes in for a small share of your notice; and it is with regret that I observe, that it has not received that due share of your attention, which would have prevented the necessity of a reply. You are surely chargeable with a very superficial review of my little volume, when the only deduction you make from my statements, is to say, in reference to my theory on the formation of bars, that "this is neither more nor less than to say, that wherever the motion of the water ceases, all matter which has been held in it obeys the law of its specific gravity: we cannot call this a new theory." Neither do I call the above a new theory; but I do deny that my title to the claim which I have advanced, of having propounded a new and useful theory, rests upon the sole foundation which you have been pleased to give it. I do say that hitherto the new Editor of the "Surveyor, &c." has not done me the justice of maturely considering the subject which he has criticised; and moreover, it is one of too much importance to be lightly set aside.

If you had stated that Mr. Brooks based his new theory for the improvement of the bars of rivers on the discovery by him, that bars (properly so called) were only to be found at the mouths of those rivers in which a great difference existed between the amount of the relative flow on the bar, and at situations not remote from that bar; in other words, that bars are only found at the mouths of those rivers, in each of which a considerable fall or slope exists at low water in its lower reaches,—you would have given something like a proper version of the subject.

I imagine also, Mr. Editor, that if you read a few more of the pages of my little work, you will be able to state that a good practical deduction may be made from my theory on the cause of the existence of bars. In numerous examples, I have pointed out wherein the difference exists between rivers with, and rivers without bars;—and it is on that difference that my theory for the improvement of the bars of rivers is based.

Moreover, I have in my work (small as it is) pointed out all the causes which *create* that difference, and have shown that in most rivers those causes may be diminished in extent, and consequently in their effect of creating and maintaining a bar. You will find that I state that the greater the fall of the surface of the river, if taken at low water, in a given length of channel, by so much the worse will be the condition of the bar.

Again, that consequent upon the above previous feature of a bar river, will be the greater duration of the period of the ebb over that of the flood tide, and consequent longer opposition to the tidal influx, *and hence the cause of the existence of bars*—and hence my claim to have discovered the true cause, why bars are found at the mouths of some rivers and not at others. Mine is not a theory chalked out in a London office, but is based upon an accurate examination of the workings of nature.

I have shown that where there is, as in the Humber, or in the Thames, an extremely small fall of the river, there no bar (properly so called) will be found, because, where this distinguishing feature exists, the return of the flood tide is not checked by the waters of the ebb, beyond the proper period of the duration of the ebb-tide at sea. The interval of rest is, as at sea, extremely small, and consequently there is not time for a deposit to take place *across the channel, forming what is termed a bar.*

I hope that I have by this time made my theory more intelligible and that you will see, that in it there is a distinction and difference from the theories which had been previously propounded on the subject of bars.

I am, Sir,

Your most obedient servant,

Guildhall, Newcastle-on-Tyne, W. A. BROOKS.
September 16, 1842.

[It seems we have offended Mr. Brooks in one of two ways,—either by not noticing his book at greater length, or by misrepresenting the nature of the theory which he has propounded on the subject of bars. If it be on the former account that Mr. Brooks' anger is excited, however much we may regret having given cause for this, we can only observe in reference to it, that the Editor of a work, who is to be taken as a strictly unprejudiced judge of *all* the books which come under his notice, must at least be better qualified to meet the taste and the wishes of his readers with respect to the space which can be afforded for observation on any particular work, than the prejudiced and partial author of that work can possibly be. With every respect therefore for Mr. Brooks, and in the most perfect spirit of courtesy towards him, we nevertheless do not hesitate to declare as a general principle, that we are not in need of any instructions from the authors of books as to the space which should be devoted to reviews of them in our pages. This is a subject on which we hold our own opinion to be the most sound and judicious, because we alone occupy a perfectly impartial position, and because we alone are acquainted with attendant and temporary circumstances, which in every journal necessarily curtail, in particular cases, the length of review which might otherwise be given to any particular book.

But in case Mr. Brooks should found his complaint upon an alleged misrepresentation of his theory, we shall quote the only passage from our review which contains any allusion to that theory, in order that our readers may judge for themselves, by comparing the passage with Mr. Brooks' own statement of his theory, whether we have indeed been guilty of such misrepresentation. The following is the passage:—"We confess we do not quite understand what Mr. Brooks calls, in his table of contents, a New Theory on the Causes of Bars; he seems to refer their formation to an endeavour of the flowing tide up a river being defeated, which defeat causes it to yield the sand, or whatever may be suspended in its volume, as the deposit which constitutes the bar. Now this is neither more nor less than to say, that wherever the motion of the water ceases, all matter which has been held in it obeys the law of its specific gravity; we cannot therefore call this a new theory." It is perfectly inconceivable to us how this can be called a misrepresentation; the whole being in fact founded on a supposition, whereas, to form a misrepresentation, it should have been founded at least on a positive assertion. Thus, we do not quite understand what Mr. Brooks calls a new theory—if it be so and so, we cannot call it a new theory. This is just what we have said, and, therefore, if we have failed to understand what Mr. Brooks' theory really is, there is an end of our remark altogether, which only applied to what we did conceive his theory was, and if his theory be something else, then our remark to the effect that it is not new does not apply to it at all. If it be necessary to explain why we did not introduce Mr. Brooks' description of the conditions under which bars are formed, and which description, it appears, he terms his theory, it may be sufficient to state, that this omission was purposely made, because we do not agree with Mr. Brooks in the conclusion he derives from it,—in other words, we do not think "that bars (properly so called) are only to be found at the mouths of those rivers in which a great difference exists between the relative flow on the bar." The truth is, that not agreeing with Mr. Brooks in this opinion, we were, at the same time, unwilling to provoke a controversy by dragging in this view of his purposely to express our dissent. However, in order that no possible reason for complaint on the part of Mr. Brooks may now exist, we have freely inserted his letter, containing in his own words a description of his theory on the subject of bars. It will be observed that there are several points in Mr. Brooks' letter which can scarcely be said to be called for at all by the review to which he is replying. For instance, we had no intention whatever of discussing Mr. Brooks' title to the claim of propounding a new theory at all, nor did we profess to explain in any way upon what foundation this claim rested: however, as before observed, we are perfectly willing that Mr. Brooks should have the opportunity of stating all these things in his own way. In conclusion, we honour the manly and straightforward spirit in which Mr. Brooks comes forward in defence of his principles. Our general opinion of his work on the Improvement of Rivers is exceedingly favourable, and although we differ in our views respecting the conditions under which bars are formed, we are still happy to add that Mr. B.'s work contains much useful information, and is well worth a perusal by all who are interested in the subject. On a future occasion, however, we shall have to lay before our readers some practical data, drawn from observation of the principal British rivers, which we conceive will justify the dissent which we thus find it necessary to express.—Ed.]

ON THE MEANS OF PREVENTING MOISTURE FROM RISING IN THE WALLS OF HOUSES.

BY M. JANNIARD, ARCHITECT, IN A LETTER TO THE EDITOR OF THE REVUE GÉNÉRALE DE L'ARCHITECTURE.

In 1839, I constructed upon the bank of Lake d'Enghien a three-story house, the foundation of which is laid about four feet six inches below the surface of the ground.*

The whole of the foundation of the front and partition walls was levelled off at the surface of the ground floor, and covered with a layer of bitumen of Seyssel, two-fifths of an inch in thickness, sprinkled over with coarse sand. Since that time no trace of damp has been discovered on the walls of the ground floor, which are chiefly painted in oil of a grey or stone colour, although it is well known that the least dampness exhibits itself in walls so coloured, by a number of round grey spots, more or less distinct; and it should be observed that the brick floor is only raised from two to three inches above the water. The layer of bitumen having been broken and taken up in order to insert the sills of the two doors, marks of moisture were observed on the part below the bitumen. The lodge belonging to the house being constructed on a more elevated situation, with the same kind of materials, but under conditions more favourable, its walls were built without the bitumen. The foundation does not descend so low as the water, and the ground floor is planked, but still the lower parts of the walls bear the marks of the damp. This is an evident proof that, in the first instance, it is prevented from rising by the use of the bitumen. I confess I was not without some fears that the bitumen would be compressed and softened by intense heat, although I was well convinced that walls twenty inches in thickness could not be subject to the temperature of the atmosphere, especially at the foundation, where they are surrounded by earth, and where the heat of the day is moderated by the moisture of the soil: I anticipated, however, that the layer of bitumen might possibly spread out under the pressure of the walls, and be thrust outwards along the face; but this effect has not been produced in the slightest degree. I had even supposed that the unctuous nature of the bitumen might, in case of an unequal settlement in the walls, occasion a gliding or slipping movement, which, however insensible at the time, would evidently in the end have produced very disastrous results. In order to prevent this, a row of pebbles about the size of one's fist was firmly embedded along the foundation of each wall, so as to act as a kind of support or strutting. It may be said, perhaps, that an experience of two years, and the pressure occasioned by thirty-two feet in height of block in course masonry, are not sufficient to prove the efficacy of the means here proposed; I shall now, therefore, cite another example in support of the position which I wish to establish. Another house was built at the same period, and on the same piece of ground, at the distance of only about thirty feet from the one already named. The ground floor of this house is elevated twenty-six inches above the level of the garden, and is supported by a flooring of timber work separated from the ground by a vacant space of about thirty-two inches in depth, ventilated by numerous loopholes. Previously to laying down the flooring, the walls were floated and covered with a plastering of Roman cement, about one inch in thickness. But, notwithstanding all these precautions, the damp rose on the walls

* The dimensions stated in this paper are all in English feet and inches.

more than three feet above the floor. Thus it appears from these two experiments, made in the same situation, that the house most liable to be affected by damp is in the best preservation, a result to be attributed solely to the use of the bitumen. It should be remarked, however, that the bitumenised walls are constructed as far as the third floor with grit stones set in hydraulic mortar, whilst those of the other house are of rough pieces of gypsum, grouted over with plaster, even at the foundation; and it is acknowledged that constructions in plaster, even before efflorescence takes place, absorb moisture from the soil much more readily than where mortar is used. In the space of a few days I have seen the damp rise several yards in height on the surface of a light plaster partition, whose base was inserted less than half an inch under water. To prevent the damp from penetrating through the ground floor, it is customary to cover over the surface of the walls, when painted in oil, with wainscoat, or with sheets of metal. This plan in some degree prevents a little of the moisture from evaporating in the apartments, but it is far from being sufficient to prevent moisture from rising; on the contrary, it even favours this injurious effect. The oil painting applied on the outward front of the houses is a certain means of rendering the ground floor inhabitable (query uninhabitable?), because the damp with which the base of the walls is saturated during the winter, not being able to evaporate from the exterior by the aid of the sun, and of the dry and warm air of summer, is thrown back into the interior. If from this side we oppose it by wainscoat, casings of zinc, or plasterings impervious to water, all these coverings will either decay or become oxidized, whilst the damp will still rise to the first story, especially if the walls have been plastered. We have seen in the country walls of this kind, on which the damp rose every winter to the height of more than two feet above the surface. A casing of zinc, about three feet in height, was put round them, and the following year the damp rose a foot above the casing: the sheeting of zinc was then increased to another eighteen inches in height, and the following spring the damp had further risen nearly another foot above the top of the zinc. From these facts and observations we may draw this conclusion,—that the only means of preventing the damp from invading the walls of the ground floor consists in placing between two courses of the stone work, on a level with the surface of the ground, an elastic substance, capable of resisting pressure, impermeable by water, little subject to decay, and insoluble in ordinary fluids. The substances possessing these qualities are, bitumen, lead, pewter, and some others. As we have already said, the painting with oil on the exterior of the houses is almost always more prejudicial than otherwise, as it does not expel the moisture from the interior, but, on the contrary, drives it inwards: it does not even preserve the rough casting of the plaster, but produces in it, after the application of the paint, a sort of chemical decomposition.

On all the parts to which the rain has access, the water collected in the numerous cracks which form in a few years in the coating of paint, dissolves the plaster, and produces in it a species of decomposition, which increases rapidly, and gives to the surface of the plastering the appearance of an object which has been worm-eaten. It is necessary, in order to avoid this inconvenience, to re-paint the walls every two or three years, which of course becomes a very troublesome process.

There may be some excuse for painting in oil colours the plastered walls of buildings intended only to serve a temporary purpose, but there can be no motive for painting façades of dressed stone. Private individuals are often induced to follow this practice by the example of others, or by the advice of some painter. But what shall we say to the practice of painting the walls of public buildings! Is it not deplorable to witness the effeminate appearance given by this means to the bold style of building which characterizes the barriers of Paris—witness the Barriere d'Italie, and that of Saint Denis. At these places, in spite of this remedy, the damp shows itself even in the upper stories, spreading over many square yards of surface.

If the inconsiderate application of this pretended preservative, which so miserably reduces the severe and striking aspect of stone buildings, and impresses on them a dull and soft appearance, not unlike that of a huge piece of butter—if, we say, this shameful system, condemned alike by reason and by every principle of taste, continues to increase in public estimation, the Louvre itself will not be safe from its attacks.

The only preservative plaster which we should admit upon stone walls, is one whose unchangeable transparence would neither impair the grain, the colour, nor the roughness of the stone.

Of all the applications with which we are at present acquainted, encaustic painting alone seems destined to fulfil this double object, when it shall have acquired all that perfection in its preparation and the mode of using it, of which it appears to be susceptible.

But in order that the application of any "hydrofuge" upon the vertical faces of walls may be successful, we must in the first place prevent the moisture of the soil from rising in the walls, and then find some means of completely drying the masonry before placing the covering upon it.

DRAINAGE AND CULTIVATION OF WASTE LAND.

TO THE EDITOR.

SIR,

It was with much pleasure that I perused, in your highly talented Journal of last month, an article upon Physical Geography, which not only contained facts of so interesting a character, as cannot fail to strike every contemplative mind with the importance of further investigating the resources of the country we inhabit, but may serve so to arouse the energies of the young engineer, and scientific persons generally, that suggestions may emanate from them which shall lead to improvements upon a far more extended and magnificent scale than has hitherto been attempted. It cannot be denied that much has been done within the last half century towards the improvement of our country: the facilities for commerce and manufactures have been highly augmented, and agriculture has not been neglected. No one can reflect upon the gigantic and successful efforts of a Watt, a Telford, a Rennie and a Nimmo, in the construction of roads, bridges, canals, and harbours—or the genius of a Stephenson, whence resulted the improvements in railway transit—the almost incredible increase of power attained by machinery, and the vast extent of our mining operations—and say that we have lingered in the grand march of improvement. But whilst all this is evident on the one hand, it must, I think, be admitted on the other, that the capabilities of the country are far from being exhausted. Much has been said and written in other places upon the distress of the country, consequent upon the want of employment, and it is admitted on all hands that an imperative necessity exists for immediately finding employment for the superabundant population. Various methods of accomplishing this desirable object will readily suggest themselves to the inquiring

mind; and it has struck me, Sir, that at once the most effectual as well as the most profitable means that could be employed, would be one general and extensive plan, vigorously commenced and pursued, for the improvement of the waste lands. To every one at all acquainted with the geography of Great Britain and Ireland, it must be well known that vast tracts of uncultivated waste land are widely spread in every direction. Without attempting an enumeration of their localities, I may briefly mention the different descriptions of waste lands to which I allude. First, there are the flat and low lands, partially, and in some places entirely, covered with water, which at present deserve no higher appellation than that of "bogs," or "swamps;" of this class, abundant examples are to be found in Lincolnshire, Bedfordshire, Cambridgeshire, and Norfolk, as well as in Ireland, where they prevail to so great an extent, as to form, proverbially, no insignificant feature in the rich, and otherwise luxuriant scenery of the green island. Secondly, there are the barren heaths, such as are to be seen at Bagshot, Salisbury, Hampstead, Dartmoor, and, indeed, in almost every county in England, as well as in Scotland, where they exist in such immense tracts, that the country has been not inaptly termed "the land of green heather." Thirdly, the lands covered with stunted timber and brushwood, of little value, thousands of acres of which might, at a small expense, be brought into so high a state of cultivation, from the natural richness of such soil, as would render it the most productive land in the kingdom. In addition to this, large tracts of land might, by the aid of embankments and drainage, be recovered from the sea, which has encroached to a considerable extent on the coasts of Great Britain and Ireland.

To recover and cultivate these lands, then, is the method I would recommend for at once giving employment to the redundant population, and increasing the natural productions of our own country; and having now briefly pointed out a field of operation, in which capital might be expended, and abundant employment afforded to the labouring classes, it is incumbent on me to provide an answer to the question, "Will such capital be profitably expended?" To such a question I would point to the Highlands of Scotland for an answer, where the greater portion of the productive land has been brought into cultivation under peculiarly disadvantageous circumstances. Neither the mountain ridge, nor the stony rock, the sandy soil, nor the barren heath, the steep inclinations rendered almost inaccessible for the want of roads, the almost entire absence of manure, nor the totally unsheltered nature of the country, presenting one would imagine a formidable barrier to the progress of cultivation, have checked the efforts of the hardy mountaineer to cultivate his bleak and barren land. The luxuriant herbage and the waving corn, with the unequalled timber, the finely tilled and highly cultivated land, speak to the success which has attended the energy and perseverance of our brethren in the north. If such have been the effects of skill and labour there, how much more may not be expected where few of the disadvantages I have mentioned exist to any considerable extent.

I might enlarge greatly, Mr. Editor, upon this important branch of physical geography, but, uncertain whether it might be considered suitable for your columns, I shall now conclude by stating, that I should feel happy, if this be inserted, to revert to the subject on a future opportunity.

I am, Sir,
Your most obedient servant,
A Friend to all Improvements.

London, September 20, 1842.

THE SCREW PROPELLER.

In our review of Mr. Galloway's treatise on this subject, we enumerated the names of the parties whose patents had been described by him. In addition to the statement contained in the subjoined letter from Mr. Lowe, we have since been informed that Mr. Galloway has wholly omitted to describe several modifications of the screw propeller. Whilst we are wholly at a loss to account for this omission on the part of Mr. Galloway, it will be obvious to Mr. Lowe and others whose patents have not been noticed, that we are in no way answerable for the neglect of which they justly complain, because we only professed to enumerate those which had been described by Mr. Galloway. We insert Mr. Lowe's letter at full length, but of course we can express no opinion as to his claim to priority of invention, nor, until further experience has been obtained, can we venture to agree in the superiority of any one form of submarine propeller over another.—Ed.

Sir,

In your review of the work of Mr. E. Galloway, "On the Archimedes Screw, or Submarine Propeller, Appendix D," and inserted in your Journal for the present month, there is a very great omission in enumerating the several names of parties who have successively taken out patents for propellers, and it is the more remarkable, as the name of the invention unnoticed is the *only* one that has succeeded in accomplishing what it professes to perform.

As you have not supplied the name which is omitted in your remarks, and well knowing your impartial and correct notions of honour, as also your love of justice, and desire to reward ingenuity, whether found in the rich or the poor man, I feel no doubt that you will open your valuable columns to forward the claims of myself by the insertion of a short history of the successful propeller by the segments of a screw.

The various inventions which have appeared for propelling vessels through the water, have all, except mine, failed to accomplish the object which it is essential for every propeller to possess, and that is *speed*. Those which have partially succeeded, have done so only as they have approached my patent segments of a screw.

In the year 1817, there were but four steam boats on the river Thames, namely, the London Engineer, the Father Thames, the Richmond, and the Hope: the latter was the first vessel to which the screw was applied. It was fitted with a *whole* screw, and failed.

In the year 1826, Messrs. Shorter and Lowe fixed to the bows of the Royal George barge, owned by the Goldsmiths' Company, two parts of a screw, in the form of curved blades. An experiment was made, and this also failed.

In 1834, I produced a model with two blades or segments of a screw, to be placed at the stern of a vessel, which, upon trial, was found to perform well.

In 1836, I became acquainted with a Mr. Joseph J. Oddy Taylor, who was shown the model I made in 1834, and he entered into a *written* agreement with me, not to take any undue advantage, or deprive me of the benefits of my invention. I made a second model for Mr. Taylor, but for two years the taking out a patent was delayed. In 1838, I was informed that Mr. Taylor was about to take out a patent for a propeller upon my model, when, to secure my right, I took out a caveat to protect myself from his obtaining a patent. This was followed by Mr. Taylor taking out a caveat

also. Mr. Taylor and I met at the office of the Attorney-General, Sir John Campbell, who heard the statements of both parties. I produced the agreement signed by Mr. Joseph J. Oddy Taylor, and also claimed the model brought up by him, as being the one made by my own hands. Sir John then asked Mr. Taylor if he admitted his handwriting to the agreement, when he said he did; upon which answer, Sir John immediately declared that I was entitled to the patent.

The patent was then taken out by me, and the specification was completed, and bears date March 24th, 1838.

Since that period my patent has been the sport and plunder of all sorts of pirates; while none have dared to dispute my title, some have encroached upon my patent right, and others have applied my segments of a screw and openly set me at defiance; knowing that to a poor man the entanglement of the law would be, as it has been in my case, a denial of justice.

In the autumn of 1838 I fitted my patent propeller, composed of the segments of a screw, to a boat named the Wizard, and made trial of her, having on board Mr. Francis Pettit Smith, the inventor of the Archimedes Screw, and Mr. Wimshurst, starting from Deptford pier to Mr. Wimshurst's yard, and the result of the trip was pronounced to be successful. This was at the time the latter gentleman had the Archimedes on the stocks.

After this time a vessel with my patent segments was worked in the Thames above and below bridge about October, 1838, with a party of gentlemen on board, and found completely to answer every expectation. Among these gentlemen I may mention Mr. Anderson, Mr. Cox, and Mr. Soaper, of the Central Coast of America Company, who remarked that the experiment had proved the practicability of my *patent* propeller.

Since my patent was granted there have been several others taken out, infringing upon mine, and the success of these appears to be proportionate to the extent of the trespass.

The first of these was Mr. J. Taylor, who has never acted upon it.

Then came a boat by Capt. Carpenter, R. N., and worked by hand labour, but that did not succeed.

After this a patent was taken out by Capt. George Smith, R. N., but up to this time it has not been tried; and he has admitted to me that his patent was an infringement upon my propeller, and I must acknowledge to his honour as a gentleman that he has not carried out his patent.

Again, another screw propeller was brought out by Mr. Hunt, and patented in that name, which came so palpably from my patent segments, that none but experiments have ever been attempted by it. The name of this vessel is the "Infant Prince," and she usually lies at Deptford Pier.

The next patent was granted to Mr. Blaxland, whose specification is expressed in terms so closely resembling mine that the description reads as having mine for the groundwork. There can be no subterfuge upon it; and to him I have delivered a notice of the piracy, and the boat which carries my patent segments of a screw has ceased to run.

I have thus briefly alluded to the history of the screw-propeller, as applicable to my segments. There are other propellers invented, as Fyfe's, Rennie's, Napier's, but it is needless to refer to all.

With these facts before you, the glaring omission of the name of my patent right to the segments of a screw as a submarine propeller will, I am sure, cause your correct and honest judgment to coincide in opinion with mine, as to the value of Mr. Galloway's work, and convince you that it must be pronounced partial and imperfect, and as a book of reference unworthy of any confidence. This notification may, however, refresh Mr. Galloway's memory, and by the time a new edition of his work is wanted, instead of my name being unnoticed by him, he will have to leave all others out.

I am, Sir,
With much respect,
Your most obedient servant,

Sept. 20, 1842. JAMES LOWE.

ON FRENCH ARCHITECTURE OF THE RENAISSANCE STYLE.

FROM THE REVUE GÉNÉRALE DE L'ARCHITECTURE.

WHEN Charles VIII. led his army into Italy, great was the astonishment of the French to find the arts of that country in a condition widely different from that which distinguished them in France. In Italy, thanks to the genius of Bramantio, Michael Angelo, Palladio, Balthazar Peruzzi, and other able artists, who rank as the authors of this style, the imitation of the architecture, the sculpture, and the painting of the ancients was already practised in all its splendour. At this period, in which the style of the middle ages was abandoned, the return to the study of antiquity was called the *Renaissance*, and it was chiefly amongst the Italians that this new style first made its appearance, a fact which will excite no surprise when we remember that in their soil were entombed the most precious relics of classic antiquity, and that even the architecture of the middle ages had never ceased at any period to preserve some traces of the Roman style.

Philip de Comines tells us that Charles VIII., struck with what he saw beyond the Alps during his rapid conquest, sent for the most skilful artists to contribute to the decoration of his *chateau d'Amboise*, and there probably are to be found the first germs of the French Renaissance. Soon after Louis XII. made war on the Milanese, in order to establish the succession of his ancestor Valentine of Milan, and this event again brought France and Italy in contact, the benefit of which was speedily seen in the royal castles of the former, in the mansions of her nobility, and even in her private houses. The military style of architecture which characterized the preceding centuries gave place to the civil, and every day bore witness to the improvements which advancing civilization introduced into her domestic architecture. Whilst under the influence of the Renaissance style, the private residences exhibited more of unity in their general architecture, and more harmony in their exterior contours, at the sacrifice of the picturesque and occasional happy effects which it displaces; it is due at the same time to the new style, and particularly to that which was introduced in France, to observe, that it always impressed upon the structure an agreeable aspect, by a certain arrangement of pleasing lines and forms, and by an ingenious combination of architectural details, to which were added the beauties of coloured marbles, with the richest graces of sculpture and statuary.

At the period of the Renaissance the interior of their buildings became simpler and better arranged than in the preceding centuries, sometimes perhaps at the expense of many useful details, for instance, the numerous staircases which were placed at every angle of the apartment, making each part independent of the other. This,

however, destroyed the unity of the exterior architecture, and, besides, was a proof of feebleness, and denoted a want of skill in the art of distributing the passages and the principal entrances in a convenient manner. Since the commencement of the nineteenth century the French have made great progress in this branch of architecture; the greater part of the chateaux of the Renaissance style no longer exist, and we have only to open the work of Ducerceaux to be satisfied of the immense loss which has been inflicted by the band of spoliators to whom their destruction is due.

LONDON ELECTRICAL SOCIETY.

Tuesday, Sept. 20.—The first paper read this evening was a communication from Mr. Weekes relative to the History of the Acari Galvanici. Repeated observation has proved to him, that whatever be the origin of these creatures, the species are propagated by the ordinary modes of generation. He has seen race succeed race; and observed that the survivors prey upon the defunct. His hopes of securing specimens of the insect have been entirely frustrated; the gradual decrease in the number of insects led to his opening their hermetic prison, and the only one insect within it, and that a microscopic one, soon disappeared. He anticipates some interesting results in relation to the spongy aggregation found at the oxide, which promises to prove an inferior oxide of silicon. —A paper by B. Snow Harris, Esq., was then read, being Observations on Mr. Walker's Papers on Lightning Conductors. The matter at issue with regard to lightning rods is, whether a shock will or will not pass from them to vicinal bodies. Mr. Harris admits that it will divide among continuous conductors, but not among semi-isolated bodies; and appears to give the two cases as instances, the one of "the division of the discharge;" the other, of "the lateral discharge." In denying the latter, he denies the necessity of connecting metallic masses with the prime rod. As Mr. Walker had given reasons to show why the Leyden jar should be banished from lightning experiments, our author analyzes these reasons under the conviction that a Leyden discharge does resemble a flash of lightning. With the principles of the experiments he agrees, but not with the deductions, and acknowledges the *distinction* between the two discharges, but not the *difference*. The direction of a Leyden discharge does not alter its character, and the shortness of the Leyden shock is entirely an affair of intensity. He gives reasons for objecting to the experiments with the prime conductor, and shows what he conceives deficient in them to complete the analogy with nature. He alludes to the security produced by an efficient lightning conductor, and concludes that there is no need of connecting detached metallic masses with it. Mr. Weekes's Electro-Meteorological Register for August was then laid before the Society. We observed that in more than one instance the intense heat of the weather melted the cement by which the insulating apparatuses are held together, and that the wire fell from St. Peter's church. It was stated that Mr. Harris's paper would be printed immediately. It appears in the same part of the proceedings with Mr. Walker's.

INSTITUTION OF CIVIL ENGINEERS.

(Continued from page 253.)

Mr. Macneil had seen at the mouth of the Helder, in North Holland, banks, nearly vertical, constructed of sea-weed and hazel-wood fascines, backed with clay: they were exposed to a very heavy sea, and yet stood extremely well—there was considerable elasticity in them, for when a wave struck them the vibration was felt at a distance along the bank. In other situations on the coast of Holland the sea-banks are long slopes of sand at an inclination of 10 to 1, thatched with straw: in many places groins were built to break the length of the wave and to diminish its force; he had adopted similar groins, and found them answer perfectly.

Mr. H. R. Palmer observed that the form suggested by Colonel Jones for the faces of breakwaters did not appear sufficiently justified by observed facts; the idea was entirely of a speculative character, and was contrary to the laws of nature, which should be the engineer's chief guide. Many years ago Mr. Palmer had occasion to study very carefully the motion of the shingle beach at the harbour of Folkstone, and at several other places, and the results of his observations were published in the Transactions af the Royal Society. He found that the slopes of the surface were always regulated by the force of the waves, and the angle at which they impinged; and that when the forces were at right angles with the line of beach, the whole of the pebbles were brought down below the level of the acting forces.

At Folkstone, when the sand was thus left bare, the surface stood at an angle of 9 to 1, and that slope resisted the force of very heavy seas.

The effect of the action of the sea upon an upright surface was observable in every cliff upon the coast, and the tendency to destruction was everywhere obvious.

Shingle beaches might be considered as adjustable barriers, but in the construction of piers it was necessary to adopt some precise form. When circumstances required the walls to be nearly vertical, the line of their direction should be determined with reference to the prevailing winds. Those portions of the piers of Swansea harbour which formed even only a small angle with the prevalent winds remained firm and substantial, but that part which was directly opposed or at right angles to them has been undermined. In a design of his for a pier in Mount's Bay at Penzance, Mr. Palmer had so arranged that the angle of the main pier should be at 5° with the line of the greatest forces. Thus then a horizontal slope is in fact made as a substitute for a rising one. He attributed the failures alluded to by Colonel Jones, more to defective workmanship than to faults in the principle of the structure.

Mr. Palmer exhibited and presented to the Institution plans of Ramsgate, Dover, Folkstone, Swansea, and Penzance harbours.

In his observations of the action of the sea upon various parts of the coast, General Pasley had remarked that the slope of the beach was exactly in accordance with the materials of which it was composed; if it was shingle or decomposed rock or soft material, the slope was gradual; but if the shore was rocky, the waves had not any serious effect upon the bluff face opposed to them, except in the case of chalk cliffs. He conceived, therefore, that a perpendicular wall constructed of large ashlar work well cemented, would assume the character of a rock, and all the prejudicial action of the receding wave would be avoided.

Mr. Bull stated that the banks of the river Calder in Yorkshire, had been effectually secured from damage by means of stone pitching or setting, laid at an angle of from 45° to 50° with the horizon, and resting on a mass of stone thrown into the bed of the river below the level of the water in dry seasons. These loose stones had generally been laid at an inclination of about 25° or 30° where the depth at low-water was not great, but where the water was deep, the lower part of the slope had been made at about 45° returning at the upper part, or near the surface of the water, to the former angle of 25° or 30°. The pitching, composed of oblong stones, was laid in courses with nearly vertical joints, having the least sectional area exposed to the action of the flood waters. The stones were from 15 to 20 inches long, varying in their widths, and were laid on a bed of gravel, or soil; he preferred coarse gravel, as it was less liable to be washed out from behind the stones, which sometimes occurred with soil, unless it was of a strong clayey nature. Several miles of facing done by him in this manner had now been standing between seven and nine years without requiring any repairs. In the few instances when the loose stones at the foot had been either insufficient in quantity or so small as not to resist the action of the floods, and had been washed away, the pitching had slid down into the bed of the river without being otherwise disturbed; after it had settled, the top part had been renewed and the original line restored.

The floods in the river Calder frequently rose from 8 feet to 12 feet, and flowed with a very rapid current, consequently the pitching had to resist a powerful action, particularly at the concave side of a bend in the river, where the action was both directly upon and along the face of the work. The loose stones below the low-water mark were seldom disturbed by the floods, and where they had been removed, no damage had been sustained beyond the sliding down of the pitching as before described; such, however, had not been the case where from peculiar circumstances a perpendicular or nearly perpendicular wall had been built, instead of the pitching; in such instances a slight disturbance of the loose stones had frequently caused the destruction of the wall. Where the pitching had been backed with light soil, which was easily washed out through the joints, the stone-work had fallen into holes, as might be expected; but where a good strong gravel had been used for the backing, no such instances had occurred.

Mr. Bull differed from Colonel Jones's opinion as to breakwaters with a vertical or nearly vertical face, because any disturbance of the footing, however slight, must have a tendency to overthrow the wall, and that tendency would be in proportion as the angle of the wall diverged from the angle of repose; that is to say, if the wall was quite perpendicular,

a comparatively small disturbance of the foundation or footing would destroy the equilibrium, and the superstructure would be overthrown, but the nearer the face approached the angle of repose, the greater would be the security.

He did not mean to assert that the angle of repose was the best for the face of a breakwater, or that the same angle should be preserved from below low-water mark to the top of the structure; on the contrary, he was inclined to think that a curved section commencing from a few feet below low-water mark at an angle of 10° or 15° from the horizon, and terminating at the top at an angle of 70° or 75°, would be found a good form, and if the courses of face stones were laid nearly vertically, should the footing below low-water mark be removed by the action of the waves, the consequence would be a sliding down of the upper face, which could easily be replaced at the top, as is done with respect to the river pitching.

The proper angle for the loose stones below low-water mark would, he had little doubt, be that of repose, or nearly so, as Colonel Jones had shown to be the case in several existing breakwaters.

The face stones should be roughly squared on the beds and joints, or what is called in the North "scappled" to the form of the curve, and laid in equal courses not quite perpendicular, but inclining a little from the direction of the prevailing wind, perhaps about 10° from the vertical line.

Mr. Bull was induced to offer these remarks, for the purpose of recording a practice he had successfully applied to the protection of river banks (of which he presented drawings) and his opinion as to its applicability to the construction of breakwaters.

On the Causes of Accumulation of Deposit in Sewers, and on the hitherto generally prevalent mode of removing the same; with a description of a new Flushing Apparatus used for cleansing the Sewers in the Holborn and Finsbury Divisions. By John Roe, *Assoc. Inst. C. E.*

In the Holborn and Finsbury Divisions there are upwards of eighty miles of covered sewers, in a large proportion of which there were accumulations of deposit, which by choking the side drains and causing effluvia became sources of much annoyance. The only remedy resorted to, was to raise the deposit to the surface of the street and cart it away: this was for many reasons an objectionable process, and a careful examination of the sewers was ordered, when it was found that many causes of obstruction existed. In sewers of the same form and inclination, different degrees of accumulation existed: this was caused sometimes by a greater run of water in one than in the other: in other cases, although the flow of water was equal, the deposit was unequal; in some situations, openings having having been made to insert side drains, bricks had been left in the sewer, against which considerable deposits had formed: the admission of water from collateral sewers at right angles, and at different levels, had also caused obstructions to the continuous flow along the main line: an example is given, where, although the collateral sewer was three feet above the level of the main line, a deposit of a foot in depth was formed for several hundred feet up the stream, while below the point of junction the sewer was perfectly clear. The insertion of gully-necks frequently caused obstructions, by permitting the access of dirt and rubbish from the road.

These facts being ascertained, the next consideration was how to remedy the defects, as the locality would not permit an alteration of level, which would give a flow through the sewers sufficiently strong to carry off the deposit. After a long series of experiments (by the author, who is engineer to the Commissioners) and trials upon several kinds of apparatus, the arrangement shown by Fig. 1 was decided upon;—it consists of an iron frame set in the sewer with a hinged door half its height, fitting with a water-tight joint: it is opened and closed by means of a jointed rod, which is worked from the level of the street. A head of water is allowed to collect against the closed door until it is sufficiently heavy, when the door being suddenly opened, the whole mass of deposit is carried forward by the rush of water. The operation is repeated with a head of three feet of water at intervals of half a mile, until the whole of the accumulation issues at the outfall, thoroughly cleansing the sewer. After this arrangement of apparatus had been some time in use, an improved form with a side entrance was contrived, and is now generally adopted in situations which admit of it.

By this arrangement, which admits of an easy access to the sewers, the stop-gate can be worked without the mechanical contrivances of the other method.* This latter mode is generally adopted, and the success of the plan is stated to be perfect.

* Two explanatory wood engravings here accompany the paper, but as the description can be understood without them, we have taken the liberty of slightly altering the letter-press to suit the omission.—Ed.

All the details of the construction of the stop-gates and the sewers, as well as of several improvements in the building of the gully-holes and collateral sewers, are given, with the result of the velocities of the currents of water from heads of various heights. Drawings of all the several kinds of apparatus invented by the author were presented, and the models which were exhibited were explained by Mr. Burton, the manufacturer of the flushing apparatus.

Mr. Farey exhibited and described one of a set of Indicators for steam-engines, made by Mr. Penn of Greenwich for the French Government, to be used in trying experiments on the steam vessels in their navy.

The construction was the same as those made by Mr. M'Naught of Glasgow; but the instruments were larger and better proportioned. Mr. Farey availed himself of the opportunity of describing the construction, the operation of, and the qualities required in a good Indicator, and then exhibited a series of Indicator cards, either taken by himself or by friends whose accuracy could be depended upon. They extended from the year 1817, at short intervals, down to the present time, and showed a great improvement in the application of steam in engines: in fact, Mr. Farey was of opinion that the origin and progress of the modern improvements in engines might be traced by a series of cards carefully taken at various periods, and he promised to contribute a more extended communication on the subject during the ensuing session.

A Description of a New Arrangement for raising Ships of all classes out of the water for repair; proposed to replace the Graving-Dock or the Patent Slip in certain situations; with Observations upon the other methods used at different periods for this purpose. By Robert Mallet, *M. Inst. C. E.*

This communication describes an apparatus proposed by the author as a substitute for the graving-dock or the patent slip, in situations where such constructions would be too expensive, or an inappropriate locality prevents their adoption. It reviews the principal methods hitherto in use,—such as stranding by bilge-ways, careening or heeling over, lifting by the camel, the graving-dock, the floating-dock or caisson, the screw and the hydraulic docks (both American inventions), and Morton's patent slip: it enumerates the localities for which each of these inventions is most applicable, and then gives the objections to them. The author then describes the general principle of his invention to be, the diffusion of the load or strain over the greatest possible number of fixed points, avoiding casual and unequal strains: that there should be uniform motion, with a power proportioned to the resistance. In providing for this, the joggle-joint is used throughout. The machine consists of a platform, supported upon a series of frames with joints at each end, attached at the lower extremities to fixed points in the foundation, and at the upper ends to the under side of the platform, which is traversed by a series of beams, to the ends of which are fastened rods connected with rollers, working in grooves along a suspended railway on the cantilevers of two jetties, which are built to form the sides of the apparatus. A chain connected with all these rollers traverses in each suspended railway groove, and the power of a steam-engine and wheel-work, being applied after the vessel is floated on the platform and made fast, the frames raise the platform and vessel together gradually out of the water, permitting free access all round the ship; and when the repairs are completed, the whole is again lowered into the water. It is contended that many practical advantages would arise from this system—that the ship would not be strained,—that time would be gained, and that it is superior to the ordinary methods now practised.

The calculations of the leverage, the division of the load over the fixed points, &c., are given in detail, and the paper is illustrated by a series of elaborate drawings and a complete model of the apparatus.

Mr. Rendel thought that credit was due to Mr. Mallet for the science and the practical skill combined in the production of the contrivance under discussion; it was perhaps imperfect in some of the details, but he was inclined to believe that, in certain situations, and for vessels of moderate size, it might be adopted. Its construction would certainly be more expensive than that of a patent slip; but it would be less costly than a graving-dock, and not liable to injury from hydrostatic pressure, to guard against which frequently constituted a main portion of the expense of a graving-dock. The foundation of this structure might be simple, as the weight was distributed over so many points: he conceived, however, that unless it was established where the rise of tide was considerable, the foundations must be laid at a depth of five or six feet under low-water mark, to allow for the thickness of the frames and the

platform beneath the ship's bottom. He was of opinion that a modification of the plan might be advantageously employed for canal lifts.

Mr. Hawkins agreed with Mr. Mallet that a ship must be strained while on a patent slip, because the timbers were all bearing a weight at an angle; but more particularly when leaving the slip, as the stern floated whilst the stem was still on the cradle of the slip.

Mr. Palmer did not admit the advantages of the proposed plan over graving-docks, for, as they are now constructed, they possess every requisite convenience for examining and repairing vessels: the gates are made to exclude the water perfectly, and the machinery for pumping is so effective, that a very short time suffices to lay the dock dry. The plan might possess some advantage over Morton's slip in retaining the vessel in a vertical position, but it would be more expensive to construct, and he was not at all convinced that the objections urged against the patent slip were well founded.

Mr. Gordon observed, that the position of a ship upon a patent slip was exactly that in which it was built; he could not, therefore, understand why it should be so very injurious; besides, if the stern cradles were elevated, as was the case on some of the slips proposed by Captain Brown, the vessel remained nearly on an even keel. Another improvement introduced by Captain Brown was, substituting solid rollers for the wheels of Morton's slip, the axles of which frequently twisted, and prevented the progress of the vessel.

Among the modes of examining the bottoms of vessels enumerated by Mr. Mallet, he had omitted the "gridiron," which consisted of a strong frame of horizontal timbers resting upon the heads of piles a little above low-water mark; over this frame the vessel was moored, and on the tide receding was shored up, resting upon chocks. When it was dry the bottom could be examined, and any slight repair made before the returning tide floated the ship off. "Gridirons" existed at Liverpool, at Hâvre, and at many other ports.

The President observed, that, like the form of breakwaters, much depended upon locality. Where timber was cheap, and the rise of tide considerable, the plan might be applicable; at Liverpool, where the tide rose 30 feet, and in the Channel Islands, where the rise was 40 feet, the platform might be 10 feet above low-water mark, and still accommodate any ordinary vessel. It certainly appeared to avoid some of the main expenses of the graving-dock, in which so many precautions must be taken for preventing the springs rising and blowing up the bottom. The Institution was much indebted to Mr Mallet for the great pains he had bestowed on the communication, for the complete drawings and model illustrating it (which were presented to the Institution), and he deserved credit for the ingenuity displayed in the contrivance.

REFLECTIONS ON ANCIENT WELLS.

(FROM EWBANK'S ACCOUNT OF HYDRAULIC AND OTHER MACHINES FOR RAISING WATER.)

It may be remarked that ancient wells are of very high interest, inasmuch as many of them are the only memorials that have come down to us of the early inhabitants of the world, and they differ from almost all other monuments of man in former times, not only in their origin, design, duration, but above all in their utility. In this respect no barren monument, of whatever magnitude or material, which ambition, vanity, or power has erected at the expense of the labour and lives of the oppressed, can ever be compared with them. Such monuments are, with few exceptions, proofs of a people's sufferings, and were generally erected to the basest of our species, whereas ancient wells have through the long series of past ages continually alleviated human woe, and have furnished man with one of nature's best gifts without the least alloy.

It would almost appear as if the Divine Being had established a law by which works of pure beneficence and real utility should endure almost for ever, whilst those of mere magnificence, however elaborately constructed, should in time pass away. The temple of Solomon—his golden house, ivory palaces, and splendid gardens are wholly gone, but the plain cisterns which he built to supply his people with water remain almost as perfect as ever. Thus the pride of man is punished by a law to which the most favoured of mortals found no exception.

An additional interest is attached to several wells and fountains of the old world from the frequent allusion to them in the Scriptures, and by the classical writers of Greece and Rome. In addition to those already named, the following may be noticed:—When the Israelites left Egypt, "they came to *Elim*, where were twelve wells of water, and three score and ten palm trees." Now the grove of Elim yet flourishes, and its fountains have neither increased nor diminished since the Israelites encamped by them. Modern travellers in Palestine often allay their thirst at the well which belonged to the birth-place of David, the "Well of Bethlehem," whose waters he so greatly preferred to all others. The inhabitants of Cos drink of the same spring which Hippocrates used 2,300 years ago, and their traditions still connect it with his name. The nymphs of Scyros, another island in the Egean, in the early ages assembled at a certain fountain to draw water for domestic uses. This fountain, says Dr. Clarke, exists in its original state, and is still the same rendezvous as formerly of love or gallantry, of gossiping or tale-telling: young women may be seen coming from it in groups, and singing, with vases on their heads, precisely as represented on ancient marbles. It was at Scyros where young Achilles was concealed to prevent his going to the Trojan war. He was placed among, and habited like, the daughters of Lycomedes, but Ulysses adroitly discovered him by offering for sale, in the disguise of a pedlar, a fine suit of armour among trinkets for women.

Heliopolis, the City of the Sun, the On of Genesis, of which Joseph's father-in-law was governor and priest, and whose inhabitants, according to Herodotus (lib. ii. 3) were the most ingenious of all the Egyptians; and where the philosophers of Greece assembled to acquire the wisdom of Egypt, was famous for its fountain of excellent water: this fountain, with a solitary obelisk, is all that remains to point out where that splendid city stood.

Aqueducts, fountains, cisterns, and wells are, in numerous instances, the only remains of some of the most celebrated cities of the ancient world—of Heliopolis, Syene, and Babylon, in Egypt, of Tyre, Sidon, Palmyra, Nineveh, Carthage, Utica, Barca, and many others; and when in the course of future ages the remaining portals and columns of Persepolis are entirely decayed, and its sculptures crumbled to dust, its cisterns and aqueduct (both hewn out of the rock) will serve to excite the curiosity of future antiquarians, when every other monument of the city to which they belonged has perished. "The features of nature," says Dr. Clarke, "continue the same though works of art may be done away, the 'beautiful gate' of the Jerusalem temple is no more, but Saloah's fountain still flows, and Kedron yet murmurs in the valley of Jehoshaphat." According to Chateaubriand, the Pool of Bethesda, a reservoir 150 feet by 40 feet, constructed of large stones cramped with iron, and lined with flints embedded in cement, is the only specimen remaining of the ancient architecture of that city. Ephesus, too, is no more; and the temple of Diana that, according to Pliny, was 220 years in building, and upon which was lavished the talent and treasure of the East—the pride of all Asia, and one of the wonders of the world,—has vanished, while the fountains which furnish the citizens with water remain as fresh and perfect as ever. And as a tremendous satire on all human grandeur, it may be remarked, that a few solitary marble sarcophagi, which once enclosed the mighty dead of Ephesus, have been preserved—but as *watering troughs for cattle*. Cisterns have been discovered in the oldest citadels of Greece. The fountains of Bounarbashi are perhaps the only objects remaining that can be relied on in locating the palace of Priam and the site of ancient Troy. And the well near the outer walls of the Temple of the Sun at Palmyra will, in all probability, furnish men with water, when other relicts of Tadmor in the wilderness have disappeared. To conclude, a great number of the wells of the ancient world still supply man with water, although their history generally is lost in the night of time.

ANCIENT AMERICAN WELLS.

As wells are among the most ancient of man's labours that are extant in the old world, might we not expect to find some on these continents, relics of those races who, in the unknown depths of time, are supposed to have cultivated the arts of civilization here? We might; and true it is, that among the proofs that a populous and much more enlightened people than the Indians have ever been were at one time the possessors of America, ancient wells have been adduced. "From the highest point of the Ohio," says Mr. T. Flint, "to where I am now writing (St. Charles on the Missouri), and far up the upper Mississippi and Missouri, the more the country is explored and peopled, and the more its surface is penetrated, not only are there more mounds brought to view, but more incontestible marks of a numerous population. Wells, artificially walled, different structures of convenience or defence, have been found in such numbers as no longer to excite curiosity."

But American antiquities are so novel, so unlooked for, and so insulated from those of the old world, that learned men were greatly perplexed at their appearance, and at a loss to account for their origin. This is still

in a great measure the case. A mystery, hitherto impenetrable, hangs over the primeval inhabitants of these continents. Who they were and whence they came, are problems that have hitherto defied all the researches of antiquarians. Nothing perhaps but the increasing occupation of the soil, and excavations which civilization induces, will eventually determine the question, whether these antiquities are to be attributed to European settlers of the sixteenth century; to the enterprising Scandinavians, the Northmen, who centuries before the voyages of Columbus and the Cabots visited the shores of New England, New York, and the Jerseys; or whether some of them did not belong to an indigenous or Cuthite race, who inhabited these prolific regions in times when the mastodon, and mammoth, and megalonix were yet in the land.

No one can reflect on the myriads of our species who have occupied this half of the globe, perhaps from times anterior to the flood, without longing to know something of their history, of their physical and intellectual condition; their languages, manners, and arts; of the revolutions through which they passed; and especially of those circumstances which caused them to disappear before the progenitors of the present red men. The subject is one of the most interesting that ever exercised the human mind. It is calculated to excite the most thrilling sensations, and we have often expressed our surprise that one of the most obvious and promising sources of information has never been sufficiently investigated: we allude to ancient wells, a close examination of which might lead to discoveries equally interesting, and far more important, than those which resulted from a similar examination of Grecian wells. Dr. Clarke says, that "Vases of terra cotta of the highest antiquity have been found in cleansing the wells of Athens."

Some persons may perhaps suppose old wells in the western parts of this continent to be the work of the Indians, but these people have never been known to make anything like a regular well. Mr. Catlin, the artist, who spent eight years among those on the Upper Waters of the Mississippi and Missouri, and another gentleman who had long been east of the Rocky Mountains, among the Flat Heads and other tribes towards the Pacific, both inform us that the wild and untutored Indians never have recourse to wells. They in fact have no need of them, as their villages are invariably located on the borders or vicinity of rivers. In some cases of suffering from thirst, while travelling, they, in common with other savages, sometimes scrape a hole in sand or wet soil to obtain a temporary supply.

ON FRESCO FOR MURAL DECORATION.

(FROM MR. LATILLA'S WORK ON FRESCO PAINTING.)

Fresco (so called from its being painted on a prepared stucco while fresh plastered and wet) is the most masterly of all modes for mural adornment. The Greeks introduced it among the Romans, and most of the ancient frescoes and encaustics were the work of the former, as those of Pompeii and Herculaneum. In various parts of Italy, ancient frescoes have been brought to light, and Vasari says that such was the beauty and freshness of the baths of Titus when first opened, that Raffaelle and Giovanni da Udine, who had come to see them, remained for some time transfixed with amazement. The sight of these frescoes led at once to the execution of the loggie, and the magnificent arabesques and ornamental stuccoes which have been so justly admired. It was from Giovanni's observing the ornaments in stucco and relievo in the Thermæ, that he invented the mode of casting from moulds in the manner of the antique, with calcined marble and marble dust. Until this, castings were made of chalk, lime, and bitumen, boiled together, and poured into the moulds while hot.

Giovanni also adopted the method that Bramante had discovered, of casting architectural mouldings in lime and pozzolana. The relievos and ornaments came out satisfactorily in this manner as to impression, but not sufficiently white. He afterwards succeeded in imitating the antique, by the substitution of marble dust for pozzolana. Among the advantages of fresco for mural decoration, are the absence of glare, with exceeding purity and freshness of colour. Fresco reflecting, instead of absorbing light, renders it particularly beautiful by candle-light, though its bland mellowness of tone is at all times very charming. By the practice of this admirable mode of painting, the artist will soon lay aside the lesser excellencies required in oil, as they would not be called for, and indeed cannot be exercised in it. The firmness of touch and celerity necessary for completing the part prepared for the day, with a constant reference to the effect of the whole, will prove to the painter that more beauty is caused by simple colour, more grandeur by preserving the flow of outline, the vigour and general character of the subject, than by attending to tints, glazings, and all the intricacies of oil. Local colour should remain unbroken by various hues; and the chiaro-scuro in fresco seems amply to supply the want of variety of tints. To manage fresco well, requires a practice in the large, after which the painter may successfully treat small subjects; but the material is so adapted for an ample area, that its beauty and facility of manipulation are much lost in very circumscribed limits. In oil there are certain allurements, as transparency, depth, and richness, which, though totally without the grand essentials of art, may please, and form the principal excellence of pictures worthy of commendation. Not so in fresco, knowledge or ignorance here will be obvious; there is no evading anatomy, drawing, and expression; these are indispensable, and on this account fresco is eminently calculated to form great designers. The principal works of the renowned Italian masters are in fresco, and they, as Reynolds observes, "are justly considered as the greatest efforts of art which the world can boast." Michael Angelo, Raffaelle, Giulio Romano, Corregio, the three Caracci, Guido, Domenichino, and Guercino, were all eminent in fresco, and far surpass, in this material, their pictures in oil, simply because the former developed the higher principles. The Germans, in our own times, have advanced through the same practice, and have acquired, within a very few years, fame throughout Europe. They excel in drawing and design, but, what is quite enigmatical, have selected Francia and Perugino for their models, instead of the unaffected grandeur of the Roman school. Still the adoption of fresco is a happy omen, and cannot fail to enlarge the taste of the Germans. There are, even now, proofs of extraordinary excellence to be seen among them, by rising artists whose genius is overlooked in the present unsound gusto founded upon early art.

In large mural works the palm must be awarded to fresco, by unprejudiced and intelligent minds. The beauty of this medium is so chaste, its tones so purely historic, and so void of any meretricious admixture, that, though its pretensions are not as numerous as oil, its qualities for the grand style are infinitely superior.

ON ENCAUSTIC FOR MURAL DECORATION.

This is one of the most ancient methods of painting recorded by the Greeks, but from the fact of their disagreement as to its origin (for they impute to different painters its discovery), it would be vain in our time even to assign the period of its introduction, though it might probably have been suggested by the Mordant painting of the Egyptians. It derived its name from the materials being prepared by fire. It was used for tabular and mural works, and combined the lucid properties of fresco with much of the richness of oil, and like the former, reflected light. From the speculations on encaustic painting, a variety of modes have been discovered, and partially adopted; but among conflicting opinions, the real process of the ancients has in my opinion been overlooked, and no other of equal value substituted. Count Caylus was one of the most active movers of the research. On a premium being offered by the Royal Academy of Inscriptions, at Paris, for an encaustic that should meet with the approbation of that body, several modes were proposed by three candidates, Count Caylus, Cochin, and Bachiliere. Two of the discoveries were approved, but resolved into one, as it was thought that the conjunction would render the medium more perfect. Wax, liquified in water by an infusion of salt of tartar, formed the composition. I have, however, found that this does not thoroughly bind the colours when used as an impasto, and, moreover, requires varnish. Several experiments have since been tried, such as the following,—wax pastiles, blended by heat; colours mixed with wax, and used while hot; gum mastic and wax thrown while hot into cold water, and then pulverised and used with water colours; this was also succeeded by the application of heat; gum mastic and wax dissolved in turpentine, and heat applied to unite the whole. Some of these were burnished by passing an ivory pallette knife over the surface, others by a coat of melted wax, polished afterwards by a piece of linen or silk. But these being wholly inapplicable for large works, I pass on to some observations made by Pliny upon the ancient method. It is certain, says he, that there were anciently two ways of painting in the encaustic style,—on tablets of wax, and on ivory with the cestrum or engraver's burin. When vessels began to be painted, a third method was adopted, that of melting wax by fire, and laying it on with a pencil, a kind of painting that will bear exposure to the sun, and stand the action of salt water and the wind without injury. Of encaustic *varnish*, as applied to walls painted in fresco, with the colour of mineum for vermilion, Pliny says, "When the wall is well dried, let the best punic wax, liquified with oil, and in a heated state, be laid on with a hog's-hair brush; then let it be heated a second time, by applying blackened or charred gall nuts till the wax begins to melt, afterwards let it be reduced to the proper consistency by means of candles." From these rather vague directions, together with observations and experiments of my own, I am induced to think that the medium for *painting* was the same as

Pliny so minutely describes for the varnish; and though he only mentions wax, it may be in the way we speak of painting in oil, which is not oil alone, though any one ignorant of the process might easily suppose this to be the case, from no other ingredient being named. Wax alone suddenly chills, and offers no facility whatever for the pencil. It is true Langi gives an account of a Florentine painter, who used colours mixed with wax heated over a fire, the canvass also being heated by another fire at the back; but this could not have been the system of the Greeks, whose encaustics were on walls as well as tablets. Wax tempered with oil, I conceive, therefore, to be the medium, this works easily in impasto, and produces an exact imitation of the ancient encaustic. The colours were ground with the wax, on a heated stone, as represented in a picture at Pompeii, where the attendant of an artist in the studio is grinding colours on a slab with a fire under it. Almost every colour was employed in encaustic, as orpiment, red lead, and other evanescent colours, wax having the property of preserving them from the action of light and atmospherical changes. The oil, when used with wax, should be colourless, and a powerful drier. Nut oil, with wax, is not easily dried. The durability of the Greek encaustic must have been great, as it resisted the sun's rays, the wind, and the salt of the seas. Having long been desirous of seeing fresco and encaustic introduced into England, I have made experiments in the hope of discovering a medium combining the qualities of the two—the freshness and and luminous brilliancy and absence of glare in the former, with the richness and facility of painting in the latter: in this I have at length succeeded beyond my expectations, and shall be glad of an opportunity of displaying its powers to the public. After having bestowed much time and pains upon this encaustic, I cannot be expected, in justice to myself, to make known advantages which the ancient, with all its excellence, did not possess, inasmuch as varnish was an essential part of its progress. It was in my encaustic fret, which has since been greatly improved in richness and durability, that I painted the banquetting room of his grace the Duke of Beaufort; it being without any varnish, the effect of the whole can be seen at once. From the subsequent additions, my encaustic now approximates nearer in practice and appearance to fresco, though admitting of a higher finish; it is particularly suitable for works that are exposed to minute observation.

THE BOCCIUS LIGHT.

The new light in front of Northumberland House and Morley's Hotel, Charing Cross, is produced by the combustion of gas according to the patent of Mr. Gottlieb Boccius. We copy from the Mechanic's Magazine the following abstract of this patent.

"These improvements in the combustion of gas, as adapted to the purposes of illumination, are stated to consist in applying above the surface or jet-holes of the burners two or more concentric chimneys or cylinders in addition to and within the usual chimney of glass. The internal concentric chimneys, are connected together and kept at the proper distance from each other by rivets or other convenient means. The material employed for the body of the burners is iron, brass, copper, or other suitable metal; but for the upper surface through which the jet holes are pierced, the patentee uses thin German silver soldered into it. He prefers the latter metal for the perforated surface of the ring, having found it 'very proper for the purpose, and very durable, on account of the high temperature required for its fusion.' He generally forms the central chimney of thin sheet iron, as a cheap and durable material; but glass, or any other metal or substance, whether transparent or opaque, capable of withstanding the heat, will, it is said, answer the end. When metallic central chimneys are used, it is thought not to be necessary that the whole of the external chimney should be of glass. 'In burners of a large size it may be more economical to have a glass rising above the ring only to the height of the lower edge of the internal chimneys. In such cases the upper part of the external chimney may be of metal, and be connected with the two internal chimneys, and in situations where the invention can be placed within a glass lantern, as in the streets, the glass chimney may, without any material loss of effect, be altogether dispensed with, leaving the three concentric chimneys just described suspended above the ring.' With respect to the dimensions of the chimneys, he has found that in the single ring burners the diameter of the innermost chimney should not be much greater or less than the diameter of the burner, and that the diameter of the second chimney should not be much greater or less than the external diameter of the ring of the burner. The distance at which these chimneys are fixed above the surface of the jet-holes may be greater in small than in large burners. The patentee finds that the lamps act perfectly well when this distance is equal to the diameter of the flame at the orifice of the holes; but that in small burners the length of the flame may be beneficially increased. In burners consisting of two or more rings, these dimensions have reference to the diameter of the outermost or largest ring and flame. As a general rule for the diameter of the innermost chimney, and also for the length of flame, it must be such that all the flames shall enter that chimney, which they will do if the chimney be made of the prescribed proportions. In constructing burners of two or more concentric rings, the patentee places the inner ring at a certain height above the outer one, or that next to it. The object of this arrangement, which he considers to be a great improvement on burners of the same kind heretofore made is, to provide for the greater equality of the height of the several cylinders of flame in such burners, so that they shall terminate as exactly as possible in one and the same level, and all enter the central chimney together. He finds by this arrangement that the economy or luminous effect arising from the combustion of a given quantity of gas is much increased, an effect which he attributes in great measure to the circumstance, that nearly equal luminosity is obtained in the flames from each ring at equal heights above the surface of the greater or external ring. He has found, also, that the height of the surface of one of these concentric rings above another should be a little more than the depth of the ring. In order to provide for a more equable distribution of gas to these burners, the junction between the rings is so arranged that the gas first enters the largest ring from the service-pipe—passes thence into the second ring, through a series of pipes—and, lastly, into the outermost ring through another set of pipes. In order still further to equalize the height of the flames, and to produce an uniform luminosity in the several flames, he finds it requisite to make the jet-holes of the inner rings somewhat larger than those in the outermost ring. The perforations or jet-holes which the patentee finds to give the best results, are very small in a burner of one inch diameter; for he has found it advisable, he says, to have from 60 to 65 very small holes, in order to pass about 3 cubic feet of gas per hour; whereas the common Argand gas-burner has usually from 12 to 15 holes of a larger bore, to give equal light when consuming a much larger quantity of gas. In the case of the larger burners, he drills the holes at a distance from each other of about one-twentieth of an inch. As a general rule for the combustion of gas according to his improvement, he considers it necessary to observe that the quantity of gas supplied, or height of the flame, should be such that its top is just received within the lower edge of the innermost central chimney. 'When this is the case, the combustion will be found very perfect, and the light brilliantly white. No carbon will be deposited within any of the chimneys, and the light will be perfectly steady, the lower edge of the central chimneys defining the upper part of the light, so that the jagged or irregular edges and flickering so unpleasant to the eye in common gas burners does not exist, and the light appears of a permanent form, as a truncated section of a luminous cone.' Although a circular form of flame alone has been previously mentioned, the patentee states that the same improvements in the combustion of gas will be attained if a form of flame, bounded by straight lines, or other form than circular, be employed, provided a corresponding change be made in the form of the chimneys and apparatus.

Note.—Mr. Boccius has entered a disclaimer with the clerk of the patents, of the same date as his specification, in which he states, that having, since the date of his patent, been advised 'that part of the said invention is not new and useful,' he disclaims the following words of the title, 'in gas, and on the methods in use, or burners'—so that the title as thus amended, stands as follows,—'certain improvements for the combustion of gas.'"

THE CALOTYPE PROCESS.

Amongst the many inventions of modern genius, there are few, perhaps, which claim more deservedly the attention of the public generally, from the extreme simplicity of its manipulation and its general utility, than that branch of the photographic art called "calotype." This branch, which was discovered by Mr. Fox Talbot, in England, synchronous with the daguerreotype process, invented by the French chemists Messrs. Niepse and Daguerre, in France, differs only from the latter in this, that the calotype delineates upon paper made sensitive, whilst the daguerreotype delineates upon metal rendered sensitive.

We attended a lecture upon this subject, delivered by Dr. Ryan, at the Polytechnic Institution, some time ago, and as the calotype process is at

once simple and interesting, we make no apology for presenting our readers with a brief outline of the learned Doctor's lecture.

The lecturer commenced by directing the attention of his audience, first, to the chemical action of light upon the colours of plants and animals, contrasting especially the dingy whiteness of the animals and birds of the polar regions, with the gay and luxuriant plumage of the "minions of the south; "and, secondly, to the action of the sun's rays upon certain chemical compounds. He then proceeded to trace the history of the art of "pencilling by means of light," from its first dawn among the alchymists, through its various gradations—enumerating the experiments of Wedgwood and of Davy, resulting in failure, from their inability to fix the picture—the more successful attempts of M. Niepse and M. Daguerre—and finally, the discoveries of our countryman Fox Talbot.

After contrasting the calotype with the other photographic processes, and especially pointing out its application to the arts and sciences, and its use to the botanist, the meteorologist, the traveller, and the antiquarian, Dr. Ryan proceeded to prepare the "sensitive paper," which was done in the following manner. Having chosen good post paper, of an even texture, he brushed one side of it carefully over with a solution consisting of 100 grains of crystallized nitrate of silver in six ounces of distilled water. The paper was then carefully dried between blotting paper. It was next dipped into a solution of 500 grains of iodide of potassium in one pint of distilled water. Upon taking it out it was washed well in distilled water, and again dried. In this state it is called "iodized paper," and may be kept any length of time, as it is not yet very sensitive. To prepare it for the reception of images, the "iodized paper" must be brushed over in the dark, with a mixture of the following solutions, A and B:—Solution A consists of 100 grains of nitrate of silver, dissolved in two ounces of distilled water, to which is added one sixth its volume of pure acetic acid. Solution B is a saturated solution of oxalic acid in distilled water. Equal volumes of the two mixtures are put into a glass, and applied by means of a brush to the paper, which is afterwards washed with distilled water and dried. In this state it is ready to receive impressions of objects, and is so sensitive, that if held to the light it immediately becomes black. After exposing it to the action of light, with the image either reflected upon it, or placed in contact with it, for a few seconds it is removed, and if examined will present no trace whatever. It is now again brushed over in the dark with the mixed solutions A and B, and then placed upon a tin vessel containing hot water, when the picture begins to develope itself. When it is sufficiently developed—as it will be in the course of a few seconds—the further action of light is arrested by brushing the paper with a solution of 100 grains of bromide of potassium in eight ounces of distilled water, and afterwards washing and drying.

In conclusion, Dr. Kyan pointed out the difference between "negative" and "positive" pictures, and stated, that, although the first taken in a camera was negative, having its lights and shadows reversed, yet by placing the picture so taken in contact with sensitive paper prepared by the old "photogenic" method, or, as recommended in the calotype process, and exposing it to light, a positive copy could readily be obtained from the negative original.

We cannot conclude, without remarking on the very able manner in which the Doctor made his lecture comprehensible to the meanest intellect. Avoiding all familiarity, he was free with his audience; his object appeared to be to make himself understood by every one. The process is a very beautiful one, and by it the most delicate tracery of artificial productions, and the most exquisite shades, and lights, and tissues of natural objects can be copied with unrivalled accuracy.

The works of the calotype process may, in fact, be termed natural copies, and they are so far superior to those produced by the pencil and brush, that a magnifying power applied to them, instead of exposing defects and blemishes, serves only to heighten their beauties, and to detect new and more charming resemblances of the original.—*Sun.*

PROPOSED PLYMOUTH AND EXETER RAILWAY.

ABSTRACT OF MR. MACNEIL'S REPORT ON THE SEVERAL PROPOSED LINES.

(From the Railway Times.)

MR. MACNEIL'S Report commences by referring to his instructions from the Directors, viz., "to inspect the country between Plymouth and Exeter, and examine the various plans which have been proposed by different engineers, for the formation of a railway between those towns, and report generally which of these lines he might consider the best, and most likely to afford the greatest accommodation to the public, while it should yield the best remuneration to the party about to embark their capital in the undertaking."

Mr. Macneil then proceeded to describe his examination of the various lines which had been surveyed by Messrs. Brunel, Moorsom, and Rendel, also new modifications suggested by Mr. Rendel during the inquiry. He (Mr. M.) describes the general contour of Devonshire, in reference to the difficulty of forming a decided opinion as to the best course of a line of railway, from the mass of engineering documents thus placed in his hands. He was further aided in the inquiry by a schedule of the traffic taken on the various lines by one of the Directors, Mr. Cole, which in all the calculations Mr. M. has doubled only, although he seems to consider this is far beneath the actual increase of traffic afforded by the formation of a railway, the average increase by English railways being six times the original amount of traffic. In examining the projected line to Falmouth and Plymouth, from Exeter, by Captain Moorsom, and observing the heavy gradients and small amount of traffic on this as a trunk line into Cornwall, as compared with a line to Plymouth, through the South Hams, it was deemed advisable "to ascertain the practicability of extending the line from Plymouth to Falmouth, the connexion of these important and flourishing sea-ports, by means of railway, being a desideratum which the public convenience in other parts of the empire has already made manifest; and being therefore an essential point of view, when considering the advantages which either line will ultimately afford to the public." A section of a line, *via* Landulph and St. Germains, and also by Torpoint and St. Germains (population 2842), Liskeard (population 4287), Ashford Bridge, the Fowey river, Lostwithel (population 1186), Par Harbour, St. Austel (population 10,320), Grampound (population, 607), Tregoney (population 995), to Truro (population 15,000), and Falmouth (population 7520), were placed in his hands.

Mr. Macneil then proceeds to give a detail of each of the proposed Plymouth and Exeter lines, and gives in a tabulated form the lengths, gradients, and probable estimated expense of maintenance and motive power, with the annual traffic and revenue, that may be anticipated on each line respectively. The various data, viz.

1st. The expense of construction.

2nd. The expense of motive power.

3rd. The expense of maintenance.

4th. Of the coaching departments.

5th. The expense of the establishment—being all taken on given uniform data, which he describes very minutely.

6th The cost of land, and damages.

7th. The cost of obtaining an Act of Parliament, being placed at such sums for the various lines as his inquiries and judgment dictated. The result of the very voluminous portion of Mr. M.'s Report, in which he gives in detail every element of calculation of the five lines hereafter described, is given in a table showing the comparative capital required; annual expenses, amount of revenue, balance to pay interest, per-centage, and length of each line. The Report is accompanied by sections of the gradients, and a general plan of the lines involved in the inquiry.

Mr. Brunel's line commences at the canal basin, at Exeter (population 40,338), and follows the Exe valley to Starcross (population 2,313), near Kenton, whence it passes through Dawlish (population 3,132), and along the sea coast to Teignmouth (population 4,459), skirting the Teign river to its crossing at Hackney Cellars, passing Newton (population 3,912), at one mile and a half distant, near Kingskerswell (population 845), Dainton, Little Hempston, half a mile north of Totnes (population 4,990), through Hanger Slate Quarry by Rattery Mill, Marley, Brent (population 1,237), Wrangotor, Ivy Bridge, whence a course considerably north of the turnpike road to Hamerdon and Colebrooke, thence by the valley of the Plym, by Plympton, (population 3,665), to Crabtree, whence it diverges from the general line of turnpike road, through Lipson, under Mutley plain to Union-street, Plymouth (population 80,000).

Mr. Rendel's line over Dartmoor leaves Exeter near St. Thomas's church, passes up the Ide valley to Perridge, whence to Culver-house and Dunsford, and following the valley of the Teign, begins to ascend Dartmoor sharply at Chagford (population 1,836) to New-house, whence by Post Bridge and Prince Hall to Nun's Cross; here leaving the Moor, it falls by Leather Tor and Dousland Barn to the level of Roborough Down, thence taking nearly a straight course by Jump and Knacherknowle to Plymouth (population 80,000.) The Tavistock branch diverges from this line near Roborough Rock, and passes above Horrabridge, and near Grenoven to Tavistock (population 6,272.)

Captain Moorsom's line leaves Exeter for two miles and a half by the Bristol and Exeter Railway, whence diverging up the valley of Creedy, near Crediton (population 5,947), by the Yeo river near South Tawton and Zeal, to Oakhampton (population 2,199) whence near the general line of turnpike-road by Sourton to Lidford, where the line to Falmouth

diverges. The Plymouth line proceeds by Wheal Friendship mines to Tavistock (population 6,272), and joins the line above described as forming part of Dartmoor line from Tavistock to Plymouth.

Mr. Rendel's south line leaves Exeter to near Culver house by the general course of the Dartmoor line. Leaving that, it enters the Teign valley, and passes thereby to Newton, by Chudleigh Bridge and Kingsleighton (population 1,498); passing through Newton (population 3,912), it follows the Lemon river to beneath Denbury Hill, whence by Broadhempston and Dartington to within two miles of Totnes (population 4,990); thence it passes up a favourable valley to a junction with the general course of Mr. Brunel's line, at Rattery Mill; following this line as before described at Bittaford Bridge, but reducing the works by increased gradients, it proceeds to Ivy Bridge, Lea Mill bridge, and Plympton (population 3,665), near the general line of turnpike road, and again joins the course of Mr. Brunel's line near Farmpool Quarry; it proceeds to Plymouth with less works and increased gradients.

Having thus gone through the various lines in detail, and ascertained the different items of expenditure and probable revenue of each, it will be desirable to bring the whole under one view in the following statement, by which a comparison may be more easily made:—

MR. BRUNEL'S LINE.

Locomotive—Capital required, 1,633,327*l.*; annual expenses, 103,803*l.*; amount of revenue, 222,615*l.*; balance to pay interest, 118, 812*l.*; per cent., 7-3; miles, 48¾.

Stationary Power—Capital required, 1,693,299*l.*; annual expenses, 90,002*l.*; amount of revenue, 222,615*l.*; balance to pay interest, 132,613*l.*; per cent., 7-8

MR. RENDEL'S DARTMOOR LINE.

Water Power.—Capital required, 1,108,342*l.*; annual expenses, 70,782*l.*; amount of revenue, 130,075*l.*; balance to pay interest, 59,293*l.*; per cent., 5-3; miles, 42½.

Steam Power—Capital required, 1,159,318*l.*; annual expenses, 84,641*l.*; amount of revenue, 130,075*l.*; balance to pay interest, 45,434*l.*; per cent., 4-0.

CAPTAIN MOORSOM'S LINE.

Capital required, 1,239,022*l.*; annual expenses, 85,404*l.*; amount of revenue, 123,383*l.*; balance to pay interest, 37,979*l.*; per cent., 3-0; miles, 54½.

MR. RENDEL'S SOUTH LINE.

Capital required, 1,269,144*l.*; annual expenses, 110,385*l.*; amount of revenue, 215,762*l.*; balance to pay interest, 105,376*l.*; per cent., 8-3; miles, 47¼.

COMBINED LINE.

Capital required, 1,469,391*l.*; annual expenses, 102,462*l.*; amount of revenue, 222,615*l.*; balance to pay interest, 119,152*l.*; per cent., 8-1; miles, 49.

(*To be continued.*)

THE "GREAT BRITAIN" IRON STEAM-SHIP,

THE LARGEST VESSEL IN THE WORLD.

THE "Great Britain," or, as she is often called, the "Mammoth," steam-ship, now in course of construction by the Great Western Company at Bristol, is fast progressing towards completion. It is expected that she will be ready to float out of dock about the middle of October, and that she will be at once fitted out, and be ready for sea in the spring. The following particulars respecting her cannot fail to be of considerable interest:—Her length is 324 feet aloft, which is nearly 100 feet longer than the longest line-of-battle ship in our service. With the exception of her deck and cabins, she is constructed entirely of iron. Her extreme breadth is 51 feet; the depth of her hold 32 feet, and her registered tonnage 3,200, which far exceeds the registered tonnage of any two steam-ships in the world. She has four decks, and the fourth, which is the lowest, of iron (this latter being appropriated to the reception of cargo). The uppermost deck, with the exception of a small break in the forecastle, will be flush from end to end, and without elevation or building of any kind, so that there will be nothing above deck, with the exception of her masts and funnel, to offer resistance to a head-wind. The two intermediate decks are exclusively for the use of the passengers and the officers of the ship: they will form four spacious saloons (which together will make a length of dining-room of 350 feet), two commodious and elegant ladies' saloons, or cabins, and 180 state-rooms, each of which will contain two sleeping berths of more than the ordinary dimensions. From this it will be seen that the "Great Britain" will afford ample accommodation to 360 passengers, providing a separate bed for each, without making up a single sofa-bed in either of the saloons, and this, too, without trenching on the accommodations provided for her officers, crew, stewards' department, &c. The principal saloon will be most extensive and magnificent; its length, from end to end, will measure 108 feet, its width will be 32 feet, and its height 8 feet 3 inches. Some slight idea of the bulk of this gigantic vessel may be formed, when it is stated that, in addition to the vast space before described as being appropriated to passengers, &c. and that required for the erection of her boilers, engines, &c., she will have ample room for 1,000 tons of coal, and 1,200 tons of merchandize. The "Great Britain" will be fitted with four engines of 250 horse power each, being no less than 1,000 horse power. She will have three boilers, capable of containing 200 tons of water, and these will be heated by 24 different fires. In her construction there have been used no less than 1,400 tons of iron, in addition to the large quantity of timber required for her decks and cabins. The great experiment which this gigantic steamer is destined to solve is one of vast importance in maritime science. She will not be propelled by the ordinary mode, with paddles, but by the newly-invented screw-propeller, which has been patented by Mr. Smith, of London, and the successful application of which to the "Archimedes" steamer, has created a feeling of confidence that is destined to effect a complete revolution in the practice of steam navigation. With a view to a thorough and searching investigation of the powers of the screw, and its applicability to the purposes for which their new vessel is designed, the Great Western Steam-ship Company hired the "Archimedes" for several months, and in the course of the autumn of 1841, they made a series of experiments with screws of various forms and sizes, the result of which was, that it was found that equal velocity and as great power could be obtained with the screw as with the paddles, and that the screw conferred a great advantage on vessels propelled by it under adverse circumstances, more particularly in the case of strong head-winds. The machinery of the screw is likewise far more simple than that of the paddles, and it is by no means so great an impediment to the vessel. Under these circumstances, it was resolved by the Company not to use the paddle, but to adopt the screw with such improvements as had been suggested in the course of the various experiments. The screw with which the "Great Britain" will be fitted is 16 feet in diameter, and it will be placed under the stern, between the stern-post and the run of the ship, which situation is selected as placing it out of the reach of accidents, to which in many others it would be liable. According to the calculations of men of nautical skill and experience, the substitution of the screw-propeller for paddle-wheels will relieve the ship of fully 100 tons of top weight, while it will at the same time admit of the boilers and engines being adjusted in that part of the vessel best adapted for their reception, and where they can best act as permanent ballast. The "Great Britain" will be fitted with six masts. Of these the mainmast alone will be rigged with top-masts and yards; the other five will carry a single fore-and-aft sail each. The height of the mainmast will be 95 feet, and the canvass composing the several sails will be sufficient to cover an area of three-quarters of an acre. It is intended to fit up the saloons, &c. with a degree of elegance becoming a ship of such an extraordinary character, and the whole of her fittings will be such as to ensure the comfort of the passengers, and adorn and beautify the ship.—*Bristol Gazette.*

NEW CHART OF BRITISH ARCHITECTURE AND CHRONOLOGY.

WE have just seen the proof sheets of a chart upon an entirely new plan, about to be published by Mr. Varty, in which the successive styles of British architecture, the genealogy and armorial bearings of British sovereigns, and the leading events of history, are shewn at one view.

In all charts that we have hitherto seen, the principal object appears to have been to get the greatest possible number of events into the smallest possible space. To effect this, the type has of necessity been small, and the whole became rather a monument of industry and research, than a thing of general and *practical* utility, admired *when looked at*, but *rarely or never made use of.*

Here, on the contrary, the type is sufficiently large to be seen at a considerable distance, and the whole so distinct and easy of reference, that we have no doubt it will prove of the greatest use, not only to the student of history and architecture, but to those of more advanced years, who may be glad to have their memories refreshed on the subject of their earlier studies.

The chart will be accompanied by a small volume of explanatory notices, in which the variation of the line of succession to the throne, the

alterations which have taken place in the national arms, with the origin of those badges or devices which have successively been made use of by different monarchs, will be made intelligible to the student. The whole is executed on stone, and in the first style of art.

DOWLAIS IN 1841.

There are few persons connected with railways who have not heard of the celebrated iron works of Sir John Guest, Bart., and Co., situated within a short distance of Merthyr Tydvil, Glamorganshire. The name of these works, and, indeed, of the surrounding village, which extends over nearly seventy acres, is Dowlais; the buildings constituting which are chiefly cottages, occupied by the numerous workmen engaged at this extraordinary establishment, at which so many of the edge-rails, with which both British and foreign railways are laid, have been manufactured. Of the forty acres occupied by the Dowlais Works, nearly seven are covered with the various buildings, forges, &c. The mineral property belonging to these works extends over and through nearly 2000 acres. There are eighteen blast-furnaces, capable of making 1600 tons of iron per week, which are blown by seven powerful steam engines, two of which have 12-feet blowing cylinders and 9-feet stroke. The steam-power employed in the different operations is fully equal to 2000 horses, besides which there are twenty water-balances for raising the coal and ore to the surface; there are also 300 horses, and seven locomotive engines, employed in carrying the iron, coal, and cinder, to their different destinations. The consumption of fuel, per twenty-four hours, is at present equal to 1100 tons, including that used for domestic purposes; the coal is not of a very bituminous description, but very firm and compact, giving out intense heat on being ignited, but the different veins vary considerably in quality and thickness; one of the veins is fourteen feet thick, and the rest vary from three to nine feet in thickness. The principal veins of ironstone are below the coal, alternating with rock, clay, and shale; and below this is the limestone, which is obtained in large quantities from the crop. The population of Dowlais has more than doubled itself within the last twenty years. Some idea of the energy and enterprise of the owners of this splendid establishment may be formed, when we mention that it is only ninety-nine years since the first bar of malleable iron was rolled at Dowlais. At present there are 4500 men, 3000 women, and 3000 children, dependent on these works for their subsistence. The wages of the colliers and miners average about 25*s*. per week; the finers and puddlers earn each 35*s*.; the rollers and heaters 40*s*.; and the carpenters and smiths 21*s*. per week, respectively. The present amount of finished iron, manufactured at these works, is equal to about 450 tons of rails, and 450 tons of bars per week.

In the finishing process, the rails take double the time required to manufacture the bars, as they are reheated, rerolled, and hammered; besides which, the ends have to be sawn off and filed, and the rails carefully straightened. In these operations great care and attention are required. The proprietors of these works have a method of refining the iron which differs materially from that pursued at other works, and for which Sir John Guest has a patent. The improvement consists in running the iron, in a fluid state, from the furnace into the refinery, instead of allowing it first to curl into pigs. In one of the mills were made, a short time since, 400 tons of rails, in the course of a week. The Taff Vale Railway, constructed with one set of rails throughout, with occasional sidings, will entirely supersede the tramroad by which the produce of these works has hitherto been conveyed to the canal basin, a distance of ten miles—and the rackway to Merthyr, a distance of two miles; the former of which has an inclination of about 1 in 264, and the latter of 1 in 20. The mode of working the Merthyr branch is by means of cogged wheels on the locomotive-engines, which work into the rack on either side of the way. The locomotives used on this rack have each an 8½-inch cylinder and 20-inch stroke, the pressure of steam being 45 lb. on the square inch; the area of boiler is equal to 150 superficial feet, and the number of tubes is thirty. The velocity attained on the rack, from Merthyr to Dowlais, is equal to three miles an hour, and the ascending load to sixteen tons.

MISCELLANEOUS.

The Church of St. Mary Redcliffe, Bristol, is well known to the lovers of christian architecture, and justly admired for its varied beauties in design and execution. Built at three, if not four, different times, it presents as many varieties of style, or rather, of architectural detail. As a whole, it is full of elaborate adornment in tower, nave, aisles, transept, lady-chapel, and north and south porches. Constructed, however, with a soft porous stone, it has suffered serious injury in exterior features; for nearly the whole of the plain facing, the rib-work, string-courses, and sculptured crockets, finials, &c., are broken off and crumbling to ruin. The attention of the churchwardens and vestry having been recently directed to the appearance, and also to the stability of the edifice confided to their care, they sought the antiquarian and professional advice of Mr. Britton, who formerly wrote a history of the church, and Mr. Hosking, to survey the building, and report on its present state, and the best mode of restoring it to a sound and beautiful construction. These gentlemen having minutely examined the whole, have prepared drawings, estimates, and a report, to show what may and is desirable to be done to make Redcliff church truly as well as poetically

"The pride of Bristow and the Western Land."

The substance of their report has been printed by the vicar and churchwardens, and circulated at Bristol and its vicinity; and we learn that a public meeting is soon to take place in that wealthy commercial city to take into consideration and adopt measures to carry out the restorations proposed. It is peculiarly gratifying to us, as public journalists, to notice these "signs of the times," and witness the progress of improvement, not only in the vast metropolis but in most of the provincial cities and towns of our country. The church at Redcliff merits and demands every attention, and the most watchful solicitude of the citizens of Bristol, as well as of its immediate parochial officers.

Manchester and Leeds Railway.—A proof of the extraordinary reduction of friction on a railway as compared with that of the common road, may be arrived at by the fact, that a four-horse coach, running between London and Birmingham, left, by the wear of horse-shoes and wheel-tyres, 11¾ lbs. of iron on the road each journey of 118 miles; while at the present time a first-class carriage, weighing 3½ tons, with a brake, is now running on the Manchester and Leeds Railway per 25,000 miles with Banks's tyres, having lost in weight by this distance not more than 7¾ lbs., and, from every appearance, this carriage is likely to run a distance of three or four times the circumference of the earth without the least repair to the wheels. The wheels were old ones, repaired on Banks's plan, when put under the carriage, the cost of repair not being more than half the price of a set of wheels for a stage-coach.—*Railway Times*.

Paris and Rouen Railroad.—The *Journal des Chemins de Fer* gives the following details respecting the works of this line:—"The embankments are in progress along the line, and have been finished in several parts. There are at the present time more than 10,000 workmen on the works, and in some weeks the contractors will, it is said, be able to avail themselves of the powerful aid of locomotives. The rails, of which the supply had been in some measure delayed, in consequence of the low state of the river, are now supplied in abundance; all the contracts are in course of execution, and the different constructions are proceeding rapidly. There is, therefore, every reason to believe that the opening will take place, as the company announced, in the first six months of next year. As to the tunnels and bridges, their execution has advanced to a considerable point of completion. The bridges over the Seine, at Besons and Maisons, can be finished in a month. The tunnel at Rolleboise is entirely excavated, and will be terminated in the course of the year. Those of Villiers, Venables, and Tourville, will soon be in a state for the passage of locomotives. There only remain, therefore, the bridges of Manour and Oisset, and the favourable state of the weather renders any delay improbable. If it be borne in mind (says the *Journal des Chemins de Fer*) that eighteen months ago not a single stone was laid, credit will be given to the contractors for the activity they have displayed."

The Gypsum Quarries of Montmartre.—Gypsum is known in chemical nomenclature as the sulphate of lime, and is found in three geological positions in the crust of our globe; first, among transition rocks; 2ndly, in the red marl formation; and 3dly, in the tertiary beds. To this latter class belongs the Parisian gypsum, the most interesting in a general point of view. The beds are of comparatively modern formation, and contain besides fossil bones, a large proportion of carbonate of lime, from which circumstance it is termed the limestone gypsum. It is easily detected by its property of effervescing with acids. The heights of Montmartre contain crystalized sulphate of lime in many forms, such as the lenticular and lance-shaped. It is drawn from quarries in great quantities to the kilns, which in general are not far distant, where it is subjected to a high degree of temperature in order to drive off its water of crystalization, and when sufficiently calcined and pulverized it is fit for use, and is then commonly called plaster of Paris. When mixed with water a species of rapid crystallization ensues, and soon changes from its semi-fluid state to a solid consistence. During its consolidation its volume is increased, which gives a sharp and faithful impression of its

mould. The plaster of Paris is very much more valued by the modeller when fresh from the kiln, as it is not then so apt to contain air-bubbles, when cast. Immediately over the gypsum is a stratum, from which they make a most excellent lime. This is from six to twelve feet in thickness, and over it, and next the soil, is brick earth, from which Paris is supplied with great quantities of bricks and tiles. The vaults, which at present are very numerous, are cut out of the gypsum; they are at present rather dangerous from the great excavations which have been made.

Ireland.—The present route of post-office communication with the South of Ireland is to be continued for six months longer.

State of the Fortifications of Paris.—The forts of Mont Valerien, l'Est, St. Denis, Pantin, Noisy le Sec, Rosny, Vincennes, Charenton, Ivry, and Issy are not half finished; the forts of St. Denis, l'Ouest, Nogent, and Bicetre, are not a quarter finished: those of Vauvres, Montrouge, Courbevoye, Aubervilliers, St. Maur, and Ville d'Avray are not yet begun.

Steam-ships for the Papal Government.—The three steamers built in England for the Papal Government have arrived in the Tiber.

Manures.—Subjoined are the present prices of several sorts of manure:—Bone-dust, 21*s.* 6*d.* per qr. of eight bushels; half-inch ditto, 21*s.* 6*d.* per qr.; rape-dust, 7*s.* per ton; rape-cake, £6 6*s.* per ton; rags £4 to £4 10*s.*; graves, £5 to £5 10*s.* per ton; gypsum, 38*s.* per ton; salt, dirty, £1; clean, £1 16*s.* per ton; Lance's carbon, 12*s.* per qr.; ditto, humus, 14*s.* per qr.; soap ashes, 10*s.* per ton; artificial manure, 13*s.* 4*d.* per qr.; Poittevin's patent disinfected manure, 13*s.* 6*d.* per qr.; nitrate of potash, or saltpetre, 25*s.* 6d. to 28*s.* 6*d.* per cwt.; willey dust, £4 4*s.* per ton; urate of the London Manure Company, £5 per ton; Alexander's chicfou or Chinese manure, 21*s.* per ton.

One ton of bone-dust is equal to 14 tons of farm-yard manure.—*Bristol Mercury*.

LIST OF PATENTS.

(*Continued from page* 256.)

(SIX MONTHS FOR ENROLMENT.)

Charles Frederick Guitard, of Birchin-lane, notary public, for "certain improvements in the construction of railways."—Sealed August 31.

Charles Thatcher, of Midsomer Norton, Somerset, brewer, and Thomas Thatcher, of Kilmersdon, in the said county, builder, for "certain improvements in drags or breaks to be applied to the wheels of carriages generally."—Sealed August 31.

Robert Hazard, of Clifton, near Bristol, for "improvements in ventilating carriages and cabins of steam-boats."—Sealed September 3.

William Roche, of Prince's-end, Stafford, mechanic and engineer, for "improvements in the manufacture of mineral colours."—Sealed September 3.

William Warburton, of Oxford-street, gentleman, for "improvements in the construction of carriages and apparatus for retarding the progress of the same."—Sealed September 8.

John Wordsworth Robson, of Jamaica-terrace, Commercial-road, engineer, for "certain improvements in machinery and apparatus for raising, forcing, conveying, and drawing off liquids."—Sealed September 8.

James Insole, of Birmingham, saddler's ironmonger, for "improvements in the manufacture of brushes."—Sealed September 8.

Joseph Henry Tuck, of Francis-place, New North-road, engineer, for "certain improvements in machinery or apparatus for making or manufacturing candles." -Sealed September 8.

William Edward Newton, of Chancery-lane, civil engineer, for "improvements in machinery or apparatus for making or manufacturing screws, screw-blanks, and rivets," being a communication.—Sealed September 8.

Herbert George James, of Great Tower-street, merchant, for "certain improvements in machines or apparatus for weighing various kinds of articles or goods," being a communication from abroad.—Sealed September 8.

William Fothergill Cooke, of Copthall-buildings, Esq., for "improvements in apparatus for transmitting electricity between distant places, which "improvements can be applied, amongst other purposes, to apparatus for giving signals and sounding alarums at distant places by means of electric currents."—Sealed September 8.

Thomas Thirlwall, of Low Felling, Durham, engine-builder, for "certain improvements in lubricating the pistonrods of steam-engines, and of other machinery."—Sealed September 8.

William Crofts, of New Radford, Nottingham, lace machine maker, for "improvements in the manufacture of figured or ornamental lace."—Sealed September 8.

Thomas Marsden, of Salford, Lancaster, machine maker, and Solomon Robinson of the same place, flax dresser, for "improvements in machinery for dressing or hackling flax and hemp."—Sealed September 8.

James Wake, jun., of Goole, York, coal-factor, for certain improvements in propelling vessels."—Sealed September 9.

John Rolt, of Great Cumberland-place, colonel in her Majesty's army, for "certain improvements in saddles."—Sealed September 15.

Frederick Bowles, of Moorgate-street, London, for "a new method by machinery of preparing flour from all kinds of grain and potatoes, for making starch, bread, biscuits, and pastry," being a communication from abroad.—Sealed September 15.

Christopher Nickels, of York-road, Lambeth, gent., and Caleb Bedells, of Leicester, manufacturer, for "improvements in fabrics produced by lace machinery."—Sealed September 15.

William Henry James, of Martin's-lane, London, civil engineer, for "certain improvements in railways and carriage-ways, railway and other carriages, and in the mode of propelling the said carriages, parts of which improvements are applicable to the reduction of friction in other machines." —Sealed September 16.

John Sanders, William Williams, Lawrence Taylor, and William Armstrong, all of Bedford, agricultural implement makers, and Evan William David, of Cardiff, for "improvements in machinery for ploughing, harrowing, and raking land, and for cutting food for animals."—Sealed September 22.

Patrick Stead, of Halesworth, Suffolk, maltster, for "improvements in the manufacture of malt."—Sealed September 22.

John Juckes, of Putney, gent., for "improvements in furnaces."—Sealed September 22.

NOTICE.

Communications and books for review to be addressed to the Editor, 8, Duke Street, Westminster, on or before the 20th of the month—Advertisements should be sent before the 26th to the Publishers, Mess. Bell and Wood, 186, Fleet Street, or to the printing office, 90½, Holborn Hill.